The MINING CONGRESS JOURNAL

Volume 13 JULY, 1927 *No.* 7

MINE SAFETY and INDUSTRIAL RELATIONS ISSUE

The Object of an Industrial Relations Program
Conciliation in Labor Disputes
Establishing Safety Records at Old Dominion
Utah Copper Townsite at Copperton
New United Verde Hospital
Safety Methods at New Orient
Mine Accident Prevention
Industrial Relations at West Kentucky Coal Co.

Full Proceedings of Cincinnati Convention on:
Safety
Mine Fires
Ventilation
Cutting and Blasting

Reports of Mechanization Survey

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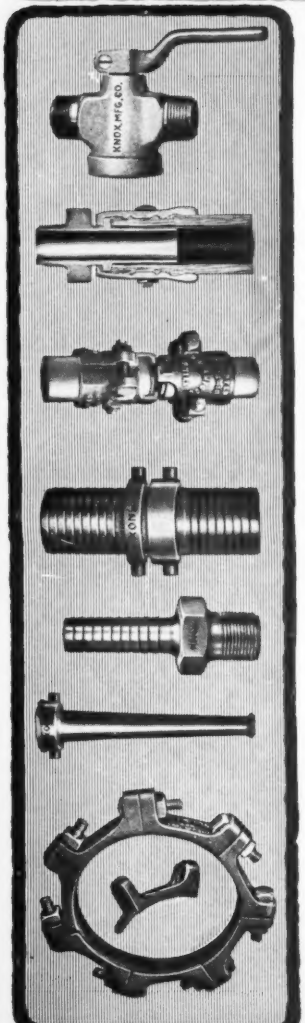

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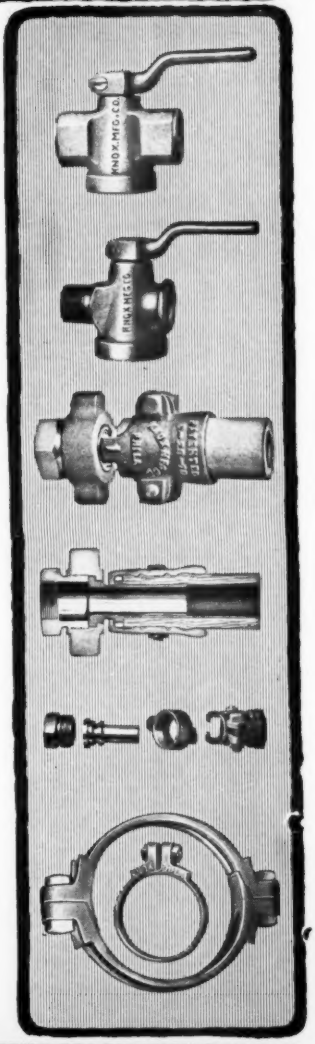

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JULY, 1927

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PRACTICAL OPERATING MEN'S DEPARTMENT

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Safety Methods at the New Orient Mine
Mine Accident Prevention
Industrial Relations at West Kentucky Coal Company

METALS

Establishing Safety Records at Old Dominion
The New Utah Copper Townsite at Copperton, Utah
The New United Verde Hospital

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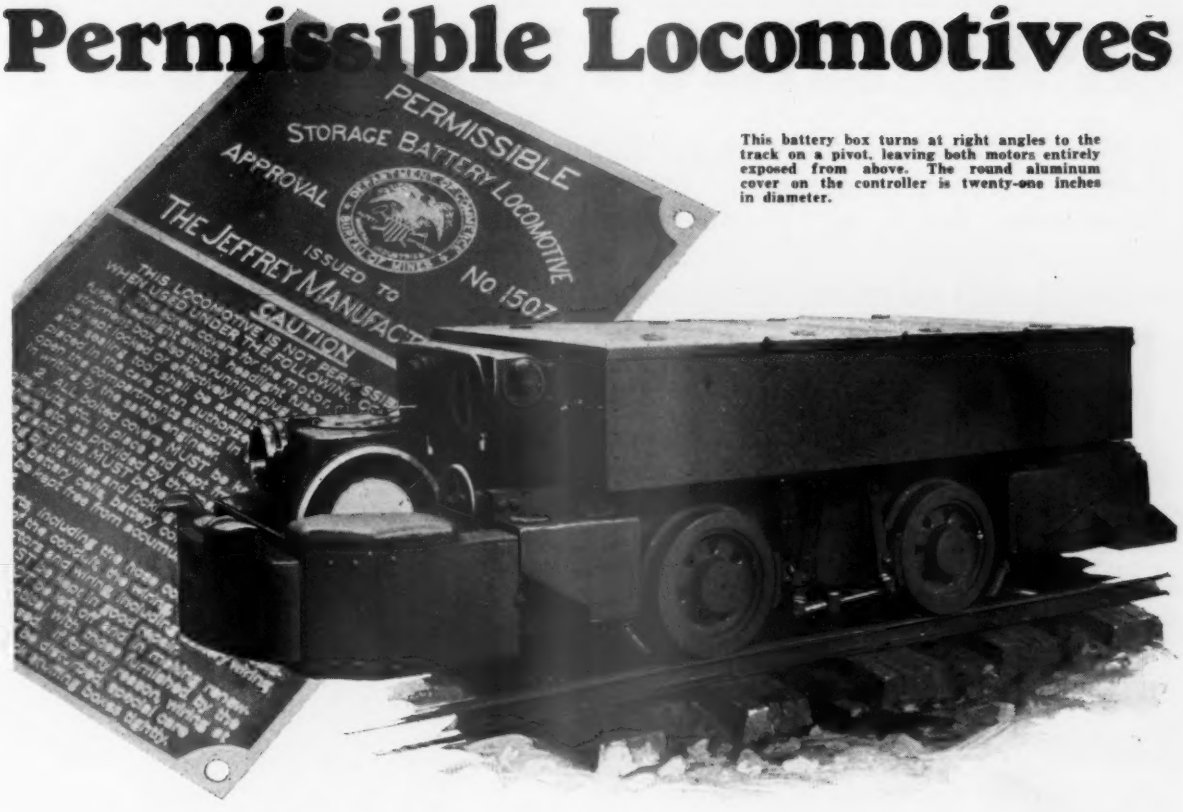
Permissible Locomotives



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Look over the features listed on this page and send for the complete story.

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THE RECORD OF THE SAFETY FIRST MOVEMENT

THE BUREAU OF MINES recently issued some startling, if somewhat misleading, figures in regard to the loss of life in mineral production. The opening statement of the release points out that "Every 10 calendar days approximately 63 lives are lost in the coal mines, and 14 in the metal mines of the country." Statistics of the bureau show that the fatality rate for the mining industry has been steadily climbing during the last 10-year period. For the period beginning in 1907 and ending in 1916, statistics show a decrease from 6.78 per million tons of coal produced to 3.77, but for the 10-year period following, the average loss ratio is 3.92. In this issue are a number of articles from both metal and coal operators concerning the methods employed to decrease mine accidents. The results obtained by these individual companies are gratifying, and show conclusively that accidents may be greatly decreased. If the entire mining industry would devote the energy to its accident problem that many individual companies are devoting, the next 10-year period would show a gratifying decrease in mine accidents. Each of these articles points out the necessity to stimulate the individual worker to special interest in his own safety record; that it is very largely an individual problem. Some of the companies have aroused this interest through awarding prizes for the best safety record, others by inaugurating plans of competition and arousing the sporting instinct of the worker, and still others by drastic discipline, such as a five-day lay-off without pay. Whatever the plan, whatever the avenue of approach, the real goal has been the awakening in the individual worker of a responsibility for his own as well as his fellow-worker's safety.

When we consider all of the agencies studying the problem of elimination of mine accidents, better results should be expected than those announced by the bureau. There are something like 25 organizations specifically studying mine safety problems. With the record of past achievement before them, they should all be convinced that something is lacking. That something, we believe, is lack of coordination. Each agency has been working separately, when a consolidation of activities, ideas and resources, would bring about a vastly different situation. The Mine Safety Movement—"Safety First"—needs a Moses. A Moses in whom the industry has faith; a Moses who can develop the same spirit of cooperation, the same sense of individual responsibility among the company units of the industry, that the various individual companies have developed in their personnel. We do not attempt to say what or who that Moses shall be. But if the facilities are not already available, they should be created, and every agency now devoting its time to mine safety problems should cooperate, should make it possible to ascertain the most reliable statistics and should make available to every mining company in the United States ideas for safety that have been successful at different properties.

Safety organizations such as those maintained by the New River Company, The Chicago, Wilmington & Franklin, The Utah Copper, The Old Dominion Company, The Phelps Dodge Corporation, to mention but a few, are well worth the emulation of the mining industry. Every coal mine operator, every metal mine operator should know of the results being obtained by individual companies, and how these results are achieved.

We urge again renewed activity in behalf of Mine Safety to the end that the next ten-year period may correspond more favorably with the period from 1907 to 1916.

THE GOAL OF INDUSTRY

A GOAL OF AMERICAN INDUSTRY has been "Friendly Relations between Capital and Labor." Many avenues have been tried by all branches of industry to arrive at the most happy solution of their problem. Recent statistics on one avenue of approach are interesting. According to the United States Chamber of Commerce, although employe representation in industry was virtually unknown before the World War, in 1926 there were 1,369,078 workers in the United States under employe representation, operating under more than 900 Works Councils in about 432 separate companies.

Various companies in the mining industry have established employe representation plans. One of the best known of these is that of the Phelps Dodge Corporation. And there are many others.

But whether it be because of employe representation, company unions, stock ownership, or any one of a number of equally meritorious plans, it is a fact that the mutual interest of management and of employe in the success of their industry is growing steadily.

Mass production, great units of industry, remote contact and control of management, make the problem a most difficult one. These inherent difficulties are being met through wise choice in executives in immediate charge of operating plants. The company that has chosen its executives from president to foreman with a weather eye to developing the most satisfactory labor conditions, is indeed a company to be congratulated.

With labor relations, as with safety, as with friendship, it is the human equation, the personal contact that bridges the chasm of discontent. One mining company has operated its properties for 24 years without one day's close-down on account of labor troubles! It did it through employe representation, which is but another name for personal contact.

HYDRAULIC MINING ESSENTIAL

ALTHOUGH THE LAST CALIFORNIA LEGISLATURE defeated a meritorious proposal which would have made possible, under certain conditions, the resumption of hydraulic mining in localities where present restrictive laws make this form of mining impossible, it is believed that California will very soon see the urgent need for this or similar legislation. This potentially great industry of California, which, during the early history of the State, contributed many hundreds of million dollars of gold to the wealth of the Nation and the world, and which provided the basic improvements that now form a part of the large irrigation and power projects of the State, is held under a legislative ban, made effective approximately forty years ago, that should be removed. The hydraulic mines should be given a new lease of life.

The principal opposition to legislative relief for the hydraulic miners comes from the agricultural interests. However, the proposed legislation was designed to protect the farmers against damage from floods and all forms of debris. Its proponents believed that it would give ample protection, and also that the resumption of hydraulic mining would be of great value to the farmers as a stimulant of local markets for their products as well as a measure of great economic importance to the State.

The State Mineralogist reported recently that within the boundaries of one county there are over 200 linear miles of lava-capped gravel channels that have never been prospected. It is said that where such gravel channels have been worked they have produced from five hundred thousand dollars to five million dollars per mile. It is estimated that six other counties each have the same amount to be worked, and that another county has about three times the amount of the first. It has been estimated conservatively that about six hundred million dollars in gold can be recovered by hydraulic mining.

The defeated plan contemplated the building of dams to restrain the tailings from the hydraulic mines, and hold back the debris from the quartz and all other forms of mining as well as the natural erosion caused by the winter storms, and to provide storage basins for flood waters which would provide extra water for the waterways in dry seasons. The dams could also be utilized for hydro-electric power development. The resumption of hydraulic mining under such a plan would unquestionably help the farmers of California. To continue the ban against it involves a great economic loss.

The hydraulic miners should not become discouraged. They should consider the recent setback as merely a temporary defeat. They should continue the campaign to educate the farmers and people of California to see the great advantages to be gained by the resumption of hydraulic mining, and without doubt they will achieve success at the next session of the State Legislature. The benefits to be derived from such legislation are so evident to those who understand the situation that no serious difficulty should be encountered in convincing the agricultural interests that the measure not only is sound but is absolutely necessary to attain the highest degree of prosperity in the State of California.

IMMIGRATION RESTRICTIONS

INCREASING IMMIGRATION of Mexicans to supply the demand for labor in this country, which formerly was supplied by immigrants from Europe who are now restricted as to number by the immigration quota law, has come to be considered as one of the most important problems with which the Federal Government has to deal. An order recently was issued by the Acting Commissioner General of Immigration reclassifying aliens from contiguous foreign countries who enter the United States to work or seek work. It is provided in the order that such aliens coming from Canada, Newfoundland, Mexico, Cuba, Central America and South America, hereafter will be considered as belonging to the "immigrant" class described in the immigration law of 1924. These aliens are given until November 1, 1927, to obtain immigration visas.

The number of natives of Mexico resident in the United States increased from 78,000 in 1890 to nearly 600,000 in 1920. The number admitted from Mexico now averages about 50,000 annually, which number almost equals the combined quota allotments of Great Britain, of Northern Ireland, Sweden, Denmark and Italy. They can not be assimilated by our communities, but they have congregated in numerous colonies throughout the southwestern states, and considerable numbers are found in all of the larger cities of the middle west and a few even as far east as eastern Pennsylvania.

The situation is extremely serious from an economic standpoint. The restriction is certain to impose an undue hardship upon the agricultural and other industries of the southwest, and also industries which depend upon labor from Canada to operate farms and factories along the Canadian border. Unless some plan can be worked out whereby the increasing demand for labor in this country can be supplied from outside sources, the normal expansion of American industry and business will be seriously retarded. The situation is most acute in the border states where it is absolutely necessary to secure Mexican labor during the periods when the crops are harvested and extra labor is necessary. Those who oppose having Mexicans come into this country because of the fear that they will spread into northern and eastern sections where they are not understood and do not mix with the rest of the population should look at the matter from the viewpoint of the prosperity and economic welfare of their southern neighbors, and allow Mexicans to enter under proper control and restrictions.

The administration and Congress should deal with this matter as a problem entirely distinct and separate from the general question of immigration. It is a matter which should not be acted upon hastily; especially as it undoubtedly involves the probability of curtailment or suspension of production in both agriculture and mining in the border states, if the restriction imposed in the order of the Acting Commissioner General of Immigration is rigidly enforced.

With respect to the effect of the ruling upon Canadian residents entering the United States, it has been stated on behalf of the President, that he understands that the chief desire of the Department of Labor is to keep the immigration laws from being circumvented by aliens coming to Canada, who are then naturalized and claim a right to enter the United States to work.

THE RESULT OF AMERICAN GENIUS

STATISTICIANS have been sharpening their pencils of late. They have arrived at the astounding facts that our national wealth now reaches the vast sum of $400,000,000,000, and is increasing at the rate of approximately $15,000,000,000 yearly. They have also estimated that the United States, with 6 percent of the world's population, is now producing and consuming more than 50 percent of the output of the entire world; also that the income of the American people in 1926 amounted to $89,682,000,000, which shows an increase of 45 percent over their earnings in 1921. The present income shows a purchasing power which has never before been equalled.

The British Industrial Commission, which recently visited the United States, upon its return home selected 13 major reasons, which in their opinion were responsible for this situation. They are as follows: immense natural resources; adaptability to changing conditions; mass production; trusts; machinery; cheap electric power; huge domestic market unhampered by internal tariffs; intelligent standardization and simplification of design; concentration of manufacture; prohibition; installment buying; friendly relations between capital and labor; and protective tariff.

On most of the points we are in agreement. We have remarkable resources in coal, iron, lead, zinc, copper and other metals. We have specialized in mass production, largely because of our rapidly diminishing labor-class. Machinery was essential to replace high priced labor. Cheap power was essential to mass production. Our huge domestic market is somewhat of a delusion and beset with many drawbacks not noted by our distinguished visitors. In England they are not faced with transportation of material over long distances to mention one flaw. Also, we produce considerably more than we consume. The standardization movement is just beginning to take hold in America. It developed simultaneously with the trade organization. So far as the mining industry is concerned with this item of success, it is in the forward van in pushing simplification and standardization of methods of production. Friendly relations between capital and labor is a thing that this country is striving manfully for. The mining industry is also a leader in this movement, with some degree of success. The protective tariff is unquestionably of value to the producer of raw material. We have no quarrel with the British for adding it to the list of things that have brought about American prosperity. Nothing very helpful can be arrived at from the commission's report. They give us no constructive criticism, nothing but an incentive to continue as we are, although their report was not intended as especially friendly. Invention, technical research, skill and organization are behind the story of our industrial progress. We pay the highest wages in the world, which has made possible greater advantages for the earners, who spend a great part of their earnings as consumers of their own product. The growing tendency toward thrift, investment in stocks, development of new enterprises on the part of our workers means increasing business activity by the widening of our domestic markets.

While the statisticians still sharpen their pencils for greater activity, and European nations send delegations to investigate our methods, American industry, American genius, and American brains will continue to lead the world.

THE COAL SITUATION

ACCORDING TO STATISTICS just released, the week ending June 11, was one of outstanding increase in production for the bituminous coal industry since the suspension began April 1. The industry produced 8,522,000 tons for that week. This brings production a trifle above the record for the first five weeks of the strike.

At the beginning of the strike the Government estimated that there was in stock, approximately 75,000,000 tons. There are no statistics to show how rapidly stocks are being depleted, although it has been conservatively estimated that it is at the rate of a million tons per week. At that rate it will take 75 weeks to exhaust the supply, if present rate of consumption continues.

According to statistics on last year's production and consumption as given by the Bureau of Mines, consumption averaged approximately 8,000,000 tons per week. By adding together all possible figures of consumption and production, it is shown that the demand is something like a million tons per week in excess of present production, which can easily be taken care of through stocks already available. The strike is still very much in evidence so far as talk is concerned, with no intimation as to final settlement. But when held up to the light for analysis, it isn't so much of a strike after all.

The miners' union undoubtedly is hoping for and expecting a threatened shortage in the supply of coal, and that this will occur at a time when householders generally put in their winter's stock of fuel. The union leaders realize that unless consumers can be stampeded by fear of a shortage and the possibility of high prices, little headway can be made in their bid for public support for their demands for higher wages, and what not, and for their legislative schemes. But it does not appear that their hopes and expectations will be realized. Conditions point the other way. And, if this is true, the financial loss to the workers as well as loss of morale and confidence in the union organization, is apt to be far greater than any possible advantage the union may ultimately gain by continuing the strike.

In Illinois and Indiana the certificate laws, which provide that no person can be employed to work in the mines until he has secured a state certificate, give the union practical domination of employment. The union controls the issuance of these certificates through the local boards appointed for this purpose which are made up of members of the union. Thus, the operators can not employ, and no one may accept employment, for work in the mines without the union's consent, and such control enables the union to wield a powerful bludgeon in dealing with the operators, and to negotiate on practically their own terms, if the operators will negotiate at all.

It is almost unbelievable that the people of any free democracy, such as ours, would sanction such legislation. Not one person in a thousand would knowingly submit to a plan which denied him the right to employ whom he desired and the right to discharge for cause when he pleased. Yet the people of Illinois and Indiana, through their legislatures have caused this to be done to the coal industry, when few, if any, of them would consent to such laws for themselves. Of course, if the administration of the certificate laws were not controlled by the union, but by unbiased and impartial boards, free from either union or operator influence, the situation might not be so bad.

Issuance of certificates to miners is not the only factor affecting coal mining in which union control is almost absolute. The use of machinery for loading and for other means in the treating and handling of coal, is controlled more directly by the union than by the operators. An operator may not adopt and install any new mechanical improvement or device for the purpose of lowering cost of production or otherwise making his operation more efficient, without running the risk of having his workers walk out on orders from the union. Thus, progress in some parts of the coal industry can not go forward without union approval.

The public has not understood or appreciated the situation in which these coal operators have been placed. Facts have been kept submerged under tidal waves of misleading propaganda, and it is only during the last two or three years that the true condition of affairs has been brought to the surface where the public could begin to see the underlying and fundamental causes for the frequent controversies and tie-ups that jeopardize the Nation's fuel supply. Wherever and whenever workers are permitted to dictate to their employers the terms and conditions of their employment, and policies affecting their employers' business, there must be trouble. And the public can now see that the coal operators have just grounds for their attitude toward the strikers.

The situation will right itself whenever necessity forces the miners to negotiate locally with the operators on a fair and equal basis, with due regard to the conditions that the operators are compelled to meet by reason of their location with respect to markets or by reason of factors affecting cost of production. As soon as it is clear to the mine workers that there is to be no Federal legislation to compel the operators to accede to their demands, the problem of both parties to the controversy getting together and reaching a mutual agreement will be considerably simplified. In the meantime, the country will not be without coal. There will be an ample supply for all necessities.

COMPULSORY ROCK DUSTING

THE AMERICAN MINING CONGRESS was one of the original sponsors for the rock dusting code, designed to lessen the hazard of explosions in coal mines. In the development of this code it was specifically stated that it was in no sense compulsory. It was merely a recommendation of something as a precautionary measure, which those sponsoring it found, upon investigation, to be worthy of the serious consideration of the industry.

Many companies have adopted the recommendations, accepted the advice, and have dusted their mines. Undoubtedly serious explosions have been prevented by this voluntary action on the part of the industry and as the facts find their way into the hands of operating men many other companies will adopt this precaution against accidents from dust explosions. Within a comparatively short time it is safe to say that every potentially dangerous coal mine will be treated with the rock-dust remedy. It isn't a cure-all, but it has in a sufficient number of cases so demonstrated its worth as to need no further vindication.

It is true that since the code has become available, it has been the basis for legislation and several states now have compulsory rock dusting laws. The mining industry does not need compulsory legislation to compel it to adopt rock-dusting or any other safety code. It is human nature to rebel at compulsory measures. Mining is a gigantic industry, and moves slowly in adopting any new idea, but given time, it will work out solutions to all its problems, without the aid of the State Legislatures, or Congress, particularly when the thing advocated has demonstrated its efficiency.

Mine safety is an individual problem. Individual companies must solve it. They can hasten the day of decrease in accident toll by rock dusting their mines, by adopting every safety precaution, and by instilling in each workman a genuine desire to make the safety record of his company something to be talked about. All the legislation in the world will not produce that result. The vindication of rock dusting as a safety measure is not a thing that "legislature everywhere would do well to note, taking appropriate action," as recently advocated by our esteemed contemporary—*Coal Age*. Rock dusting is but one precaution and its application alone will not prevent accidents. Safety can not be legislated. Its price is continual vigilance, and the biggest factor is the minimizing of the human equation.

CORPORATION TAX REDUCTION

OFFICIALS OF THE TREASURY, the Ways and Means Committee of the House, and the Finance Committee of the Senate, in their public statements, show absolute unanimity in the belief that corporation taxes should be reduced at the next session of Congress. The most recent statement was issued by Chairman Green of the Ways and Means Committee upon his return to Washington after several weeks' absence in the West. He stated that the corporation tax not having been reduced to correspond with the other taxes, would seem to be out of line and to have strong claims for consideration.

It is pointed out in his statement that the deficiency appropriation bill, the matter of flood relief, and some other items of large expense, which will have to be approved by the next Congress, may wipe out any surplus for the fiscal year 1928, and therefore in making up the revenue laws Congress must look even beyond that period. It is also pointed out that every 1 percent of reduction in the corporation tax will take off nearly 100 million dollars, and this reduction could not go very far without absorbing any surplus that is likely to exist.

Under the 1926 Act, the corporation tax is 13½ percent as compared with a 5 percent individual normal tax, or a differential against the corporation of 8½ percent. Admitting that 1 percent of the present corporation tax is in lieu of the capital stock tax, assumed to be levied upon the corporation because of its exercise of powers as a corporation, there is still a differential of 7½ percent against the corporation. Taking into account the effect of the existing corporation rate upon individual stockholders, the stockholder who is subject only to 1½ or 3 percent tax under the 1926 Act, has had any income receivable by him as dividends diminished by the 13½ percent corporation rate, making a differential against him of 12 percent or 10½ percent, respectively, as compared with other individual taxpayers in the same income class.

If the corporation rate is reduced it is not believed that the change will materially affect the revenue receipts. It is believed that such a reduction will result in the stimulation of business and that the same effects will be produced as were brought about by the reduction of the high individual surtax rates.

There seems to be no opposition to corporation tax reduction.

METAL MINING PROBLEMS

MINING MEN OF THE WEST will meet at Salt Lake City during the week of August 22 to discuss in open forum the economic, legislative, technical and co-operative problems of the metal-mining industry.

While the call for the convention is issued by the Western Division of the American Mining Congress, which is an amalgamation of state mining organizations, the meeting will have the cooperation of other organizations, such as the American Institute of Mining and Metallurgical Engineers, the American Silver Producers Association, etc. The Institute is arranging an interesting program where technical operating problems will be discussed. Their program confines itself entirely to metallurgy with particular reference to flotation.

For the first time in several years a call has been issued for members of the General Tax Committee of the American Mining Congress to meet at Salt Lake City during this convention. While the executive members of the tax committee hold frequent meetings at Washington and annual meetings in conjunction with the national conventions of the Mining Congress, the state members, and particularly the western members, have seldom been brought together. But with the Joint Congressional Committee on Internal Revenue Taxation now engaged in a study of depletion allowances, and proposals which possibly may be recommended as amendments to the revenue law, this committee meeting is deemed of vital importance.

The assembling of these groups simultaneously and their joint discussions of problems affecting the mining industry of the west will do two things: Bring about a spirit of closer cooperation in the different branches of the metal producing industry; and develop a definite program for that industry upon which all are agreed.

The combining of the discussions of economic and technical problems proved a success at the meeting held at Denver last year. It should be as successful this year. Interchange of information on technical operating problems is the basis of growth of industry. The combined discussions bring out both management and the operating personnel, and gives each an opportunity to better understand the problems of the other.

The Salt Lake meeting promises to be one of unusual interest. Its program warrants the assumption that its results will be distinctly helpful to the metal miner.

MINE FINANCING

IN ALL OF THE WESTERN metal-mining states prospecting has disclosed numerous ore deposits that undoubtedly will be developed in the future and become valuable producing mines. In many instances their development has been held back by reason of the inability of the owners to secure necessary capital; in others, by reason of the ability of existing mines to supply the demands of the metal markets; and in still others by reason of the low-grade character of the ore and the consequent high cost of production.

Of all the problems that confront the owners of a likely mining prospect, that of financing is probably the most acute. To secure ample funds from banks, a number of factors must be proved beyond reasonable doubt. A mining venture, like any other business venture, must withstand certain tests as to its soundness and chances of success. It must be so well planned that it will stand a rigid investigation on the part of those whose financial assistance is sought.

But few mines during the development stage and at the start of operations are financed by loans from banks. In most instances the money for development is secured through the sale of stock to the public. And it has been observed that the public has not been discouraged by the failures in which its money has been lost. The public will continue to supply funds for the development and operation of new mines to the point where bankers are willing to come in and supply the capital necessary to put them on an operating basis.

Except in the cases of unusually rich discoveries, it requires many years to develop a mine to its maximum production and earning capacity. But a sound proposition, properly and adequately financed, and developed under the guidance of an energetic and able management, generally returns ample reward to those who have the vision to grasp a mine's possibilities during the early stages of its development.

The viewpoint of the banker toward mining ventures was outlined recently by Hon. Waldo Newcomer, Chairman of the Board, Baltimore Trust Company, in an address before the Southern Industrial Development Conference of the American Mining Congress. He referred particularly to the manner in which the mine owner should present his case to the banker in order to secure the latter's interest in the project. He intimated that many of those seeking financial backing and who doubtless have meritorious propositions fail because their cases are not properly and adequately presented with respect to details that might be supplied if the applicants understood the requirements that must be met.

Mr. Newcomer said that before a banker could consider any proposition, he must be satisfied, first, that there is absolute integrity on the part of those interested in the mine and its management; second, that he can rely on the management, which must be not only honest but practical and experienced; third, that there has been a careful investigation covering questions of economy in mining, availability of labor at reasonable prices, demand for the product, transportation facilities, and the possible financial results of a shutting down due to strikes; fourth, he has the right to expect that a reasonable amount of cash will be put into the proposition by the owners and the management; fifth, that there is a good margin of safety, a fair margin of operating profits in sight under normal conditions, adequacy of financing to avoid additional loans and assessments, provision for a proper and ample sinking fund, and an adequate provision for depletion as the mine is worked, and, finally, an adequate profit to the bank in the transaction.

The mine owner realizes that the banker must be ultra-conservative and very exacting in his consideration of any plan for financing a mine or a business, because he is dealing with the money of other people that has been entrusted to his case. It therefore generally is absolutely necessary to finance his enterprise, during its initial or development stage, at least, by the sale of stock to the public.

The trend of public opinion toward the mining industry is favorable and capital for legitimate mining prospects should not be difficult to secure. We believe that during the next few years a large amount of new capital will flow into western metal-mining states into the development of new mines that are now considered merely as likely prospects.

THE OBJECT OF AN INDUSTRIAL RELATIONS PROGRAM

Object Of Such Program Should Be To Meet Any And All Those Matters Which Affect Living And Working Contacts Of Employer And Employe In Their Efforts To Achieve Purposes For Which Their Industry Exists

By WILLIAM LOEB *

THE EDITOR of THE MINING CONGRESS JOURNAL has asked me for a general article on "The Object of an Industrial Relations' Program."

As "of the making of many books there is no end," so it would seem that, although at the beginning of its growth, the plans already laid out for the establishment and maintenance of industrial relations as they now exist vary greatly in the objects sought to be attained; that there is no general uniformity of method or practice, and that the differences in detail are legion.

While there are many thousand concerns throughout this broad land having 100 or more employes each that do not have employe representation, there can be no doubt of a decided trend toward a fuller cooperation between management and employes, and of an honest endeavor being made in many directions to earnestly grapple with the problems growing out of operation and employment with their interlocking, though often seeming contradictions of interest, in the hope and belief that mutual understanding and a respect for the rights and duties of each other will go far to remove the friction which has so often unhappily impeded industrial progress in the past.

The most powerful influence that has ever been exerted towards a full realization of the vital interdependence between the employer, the employe, and the public, has come from the solemn lessons of the Great War. It awakened in the consciousness of men the power, strength and resourcefulness they possess when united in a common cause and purpose, and the weakness and inutility that grow out of mistrust and misunderstanding. It set a standard of what can be accomplished in striving shoulder to shoulder in reciprocal good will, and the ruin that can be wrought through cross purposes and the disregard of the feelings of others. It developed a new relationship in ownership, the results of which may be far-reaching, both through a changed attitude between capital and labor, and in the changing of old and development of new methods in industrial operation.

With the constant insistence of "give until it hurts," came its natural corollary to "stint and save to the last cent" —both "habit-forming" practices, which have rapidly developed into a marked desire on the part of employes to participate in the ownership of the concerns and industries with which they are connected.

This ownership, in one form or another, is constantly growing, and it is fair to assume that the employe-owner will look with a more alert eye and acquire a more interested attitude toward the affairs which now hold for him a double interest.

Employe representation in industry is a development from many causes. There may be those risen from the humblest ranks to the directing heads of great enterprises through their own sheer ability or because of fortuitous circumstance who claim for each step that they have taken the ancient prerogatives or assumptions so jealousy and zealously clung to—

"* * * the simple plan,
That they should take who have the power,
And they should keep who can"—

and they may attempt to ignore, but they can not forget the aspirations that crowded upon them and the conditions and experiences through which they journeyed on their forward march. Back of them press the great multitude, in their respective stations, but clamoring for a larger voice in the affairs which intimately, immediately, and vitally affect their own lives and their hopes for their children.

A healthy and honest discontent makes for the most progress in human affairs, and he is abreast of the times who takes note that his own welfare and material and spiritual security is also woven into the well-being of those who man his industry, and both, in turn, to the great mass upon whom they must ultimately depend to make use of the fruits of their joint endeavors.

Employe representation does not depend primarily for its success upon the scope of the understanding between employer and employe, but it is vital, that having entered into it, each must be honest and frank with the other to the full extent of their agreement. A representation or relation with a string attachment that may be used to tighten here or loosen there or to distort in some other direction to the disadvantage of one as against the other of the parties can never accomplish anything but the undoing of whatever good was meant to grow out of it.

It is more or less inherent in men, in the interest of true sportsmanship, to be willing to swap jackknives when each is convinced of the element of honesty and fairness on the part of the other, although a shade of advantage must accrue somewhere. But the donee of a gift horse looks with suspicious eye not only upon the donor, the steed and the intent, but will invariably violate that ancient rule of etiquette which forbids a glance at the nag's palate. Any representation that savors of a gift must be repellant and will inevitably lead to failure.

A plan set to paper and depending upon the niceties and subtleties of verbiage and not upon the spirit of the understanding itself can not endure. Made a football of by the narrow constructionist when it suits *his* purpose, and of the broad constructionist when *he* glimpses a mean and selfish advantage, it is but a waste of time for the parties to such a plan to attempt a square game.

The object of an industrial relations program should be to meet any, a part, or all, of those matters which affect the living and working contacts of the em-

* "*There is a decided trend toward fuller cooperation between management and employes and an honest endeavor being made in many directions to earnestly grapple with problems growing out of operation and employment, with their interlocking, though often seeming contradictions of interest, in the hope and belief that mutual understanding and respect for rights and duties of each other will go far to remove friction.*"

"*Any representation that savors of a gift must be repellant and will inevitably lead to failure. * * * A plan set to paper and depending upon the niceties and subtleties of verbiage and not upon the spirit of the understanding itself, cannot endure.*"

* Vice President, American Smelting & Refining Co., New York City.

ployer and employe in their common efforts to achieve the purposes for which their industry has existence, and to meet them on an equal and broad basis.

There are problems to work out, which can be done through employe representation, which do not, should not, or need not, impinge upon any of the rights, duties, or privileges, of either employer or employe, but which should be to the advantage of each and the common good of both.

The management has the problem of development, production and distribution to grapple with, and to make it profitable he must have the intelligent cooperation of the rank and file whom he directs in the enterprise.

The existence of an army depends upon selection, enlistment, training, equipment, subsistence, morale, health, discipline, wise direction, and a reason for its existence.

All these elements are the very lifeblood of a going concern, and the first consideration in industrial relations is a wage sufficient to maintain the employe in the living conditions suitable to the demands made upon him to provide for his own and the needs of his family and to take into consideration the vicissitudes ordinarily met with in life. Indeed, the ancient formula that labor is a mere commodity and to be purchased within a hair's-breadth of life's sternest necessities has been relegated to the limbo of heresies and economic falsehoods, and the new evangel proclaims that economic wisdom lies in giving the highest wage the industry can honestly afford, for the stinting of labor comes back to vex production and distribution, and these are the triangular base upon which industrial prosperity and progress are founded and have their being.

Working conditions must be such—compatible with the nature of the enterprise—that the employe must be able to carry on his duties with reasonable safety and without impairment of his usefulness or detriment to his employer. Here is a community of interest which affects both alike and in equal measure, for a poor working condition has its reflex in a limited production and a higher cost for output. The employe can only measure up in his ability to the conditions which surround him, and the employer is inevitably penalized through the difficulties he has placed in his own path by failing to recognize that good conditions enhance the value to him of his employe and of the production he would have otherwise lost through his own lack of foresight.

The health and morale of an industry is reflected by the health and morale of the rank and file who keep its wheels in operation. Dilapidation of men, as in machinery, soon spells for disaster in operation; but the good housekeeper in industry knows that that is the wisest economy which provides fully for the health and well-being of the enterprise, and wise cooperation between management and employe should be encouraged to the utmost.

> ***"Employe representation does not depend primarily for its success upon the scope of the understanding between employer and employe, but it is vital that having entered into it, each must be honest and frank with the other to the full extent of their agreement. A representation or relation with a string attachment that may be used to tighten here or loosen there, or to distort in some other direction to the disadvantage of one as against the other, can never accomplish anything."***

The *esprit de corps* of an industry must always be one of its most valuable assets, and to create and maintain this calls for character that radiates understanding, justice, sympathy, a wise discipline and a cheerful observance of it, and an integrity in all things. This spirit is not and can not be the possession of one man alone, but it must be entered into and shared by the entire personnel. It can not thrive within the walls of the factory alone and only within the hours of labor, but it must also have the sunshine of the outer air. An interest which goes into the homes of men after the whistle blows, which considers the recreations, the enjoyments, the domestic surroundings, are health and spirit builders of the first importance, and a recognition of this community of interest and an observance of it is surely one of the objects of industrial relations.

> ***"The esprit de corps of any industry must always be one of its most valuable assets, and to create and maintain this calls for character that radiates understanding, justice, sympathy, a wide discipline and a cheerful observance of it, and an integrity in all things. This spirit is not and cannot be the possession of one man alone, but must be entered into and shared by the entire personnel."***

One of the most serious facts which affects and injures labor and industry alike is labor turnover.

Its cost both to employer and employe alike has been incalculable, but which of the two has been the greatest sufferer would be hard to determine. To the employe, who foregoes his daily wage for an indeterminate period until he can secure other employment, the loss is immediate and acute, and the burden must be shared in by his family, those dependent upon him and those who relied upon him. To the employer it means a curtailed production, a derangement of system and an increased cost of operation and sometimes an aggravating loss of confidence.

One of the most important and superintending causes has been seasonal, and in many occupations this will probably always be so; but industry is awakening to a wiser system of production and distribution, which should go far to reduce this tremendous drain and human waste, and should stabilize operation and labor in a marked degree. Another, and not inconsiderable, cause for labor turnover and for which there has not yet been found a means of redemption, is the curse of the "wandering foot." The nomadic-minded workman, like the migratory bird, seems ever to be in flight except for such brief moments as he needs must procure means for a further winging. For the chronic rover little or nothing can be done; but unpleasant working and living conditions, more attractive fields just beyond the horizon, unresponsive management, and numerous other factors are largely responsible for the itinerant workman.

With the present tendency in industry to cut down peak loads of production and level up depressions of distribution, seasonal conditions which have heretofore been the bane of all concerned will in large measure disappear, and this cause of labor turnover will cease to exist.

Counsel between management and employe on labor turnover and its causes is an important object of industrial relations.

I have enumerated but a few of the many matters which can well be made the object of an industrial relations program.

Whether such a program should be laid out on the basis of advisory powers, arbitration machinery, board representation or other form is one which each industry is better able to determine. Each form has its advocates and each has been criticized; but that employe representation in some form will generally work out for the common good is, I believe, beyond dispute.

CONCILIATION IN LABOR DISPUTES

Cooperation Between Employers And Employes—Industrial Relations Adjustments Over Fourteen-Year Period—Violence Giving Way To Peaceful Settlements—Prosperity Created By New Viewpoint Of Employer And Employe

By H. L. KERWIN*

TO MY mind one of the most significant economic developments in recent years has been the healthy growth of the spirit of cooperation between the employers and the employed in American industry.

We have but to go back a few years to find that the major portion of the workers in industrial establishments in mine, mill, or factory, as well as the majority of the managers in these enterprises seemed given to thinking that what was beneficial to the worker was detrimental to the management and the workers held a similar misconception that their interests and those of the management were inevitably hostile. It was a common thing for workers to oppose any innovations in the factory in which they worked, and the management was often unwilling to give consideration to any plans put forward by the employes, each believing that only selfish interest guided the actions of the other. It was the fashion for the employer to oppose every request for an adjustment in wage rates or the betterment of working conditions, and it was the general attitude of the workers to look with disfavor on any changes suggested by the management. While in some enterprises fair dealings built up through long time association had developed a spirit of confidence, it was pretty generally believed that neither interest could be actuated by any other motive than to get the best of the bargain whenever demands were presented, or changes in production methods suggested. We have gone a long distance since this condition prevailed. Today we have a different idea as to the rights of workers and management, but for the most part it has been an awakening to the fundamental fact that satisfactory productivity depends not only on managerial efficiency and intelligent labor, but more than all else on harmony, good will and cooperation. Good management now believes in well paid workers, employed under the very best of working and sanitary conditions.

The workers in American enterprises are producing more and better commodities because they respond to the improved methods and machinery and the type of management that prevails today. The net result of this modern combination built on a basis of understanding and joint effort has made our country the foremost industrial nation of the earth. With greater production has come a greater store of wealth for each to share; more leisure to enjoy the returns and more satisfaction, contentment and better standards of living than ever before known.

It is not intended to convey the thought that we do not have any differences existing in our industrial field, because unfortunately this is not the case, and despite the fact of our tremendous advancement along the road to better and finer understanding, we still have disputes arising in this great industrial organization of ours with its millions of workers. It is estimated that there are 24,800,000 actual earners of wages, skilled and semi-skilled workers, laborers and servants; add to these people engaged in clerical and kindred work and we have 31½ millions of people on a wage or salary basis. Include all others of the gainfully employed and we have a grand total of nearly 42 millions of people. In the old days trade dispute often brought in addition to loss of work, wages and profits, violence and harsh treatment. Today we find but little if any violence attending trade controversies and the harsh treatment is gradually giving way to more considerate methods on the part of the divergent interests.

Here and there in a few industries they still cling to some of the ways of the past, but I believe that the time is at hand when we shall soon see a great majority of our industrial differences settled by joint negotiation and conference while work progresses and man and manager maintain a friendly attitude during the negotiation of a contract or settlement of a dispute.

To harmonize differences, to bring about through negotiation an adjustment of grievances arising in our industries before and not after an open break develops is the ambition of the United States Conciliation Service of the Department of Labor. To obviate strikes and lockouts we have only to study industrial history in this and other countries to find that many theories have been advanced, many plans have been devised and many agencies have been brought into existence for the one purpose of establishing and perpetuating peace in industry. Many of these have been quite successful along certain lines. Others in many instances have failed because, as I firmly believe, the plan did not reckon altogether on the human elements involved. Industrial relationship is not a question that can be solved by mechanical means. It is solely and strictly a human problem such as is religion, education, recreation or any of the other activities of our personal lives.

Statistical experts can reasonably determine the increase in population, and estimate the wealth per capita this year and next. Engineers can give you the strength of Brooklyn Bridge and the required strength of steel beams to carry various loads. All of these are possible and of pretty accurate determination, but when it comes to determining or anticipating the trend of a human intellect or the action of the individual, or a collection of individuals, we are all at sea unless we take notice of the human equation. Men react to sentiment, ideals, necessities, responsibilities, selfish interests and many other personal motives. Especially is this true in industry where personal grievances or differences grow up in the differences of opinion over production, earnings, working conditions, output, or a multitude of issues. Then it is at once evident that no general plan or set rules provide the way out. A human problem is presented and it can be solved only by going at it in a diplomatic manner and showing the contending sides that their best interests depend upon a settlement based on mutual respect and good will. This can be accomplished only by a clear cut understanding reached through frank, open consideration of the grievances, be they economic, social or financial, or in other words, the question of pay, human relations and working conditions. A settlement that is fair and just can only be secured by fair and just means. A great deal has been accomplished in the development of a better understanding between employers and workers. This ideal condition prevails today in America in a greater measure than ever before; and I feel that the various interests in the business of our country are realizing that the very best way in which honest differences of opinion may be fairly settled is through conference and negotiation. It is a method far more to be preferred than the turmoil of temper and ill will which, in years gone by, have so frequently led to frequent strikes, to serious interruptions of the Nation's prosperity, and to a settled state of discontent that rendered the worker a lesser producer throughout the year. I

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am more than pleased to call your attention to the fact that during the past fiscal year the Federal Conciliation Service of the Department of Labor was acceptable to employers and employes in 551 industrial disputes, strikes, threatened strikes, and lockouts. In 447 of these cases Commissioners of Conciliation were successful in securing amicable settlements almost immediately. Included in these are 70 cases settled in cooperation with state and local agencies and civic committees, and in only 61 cases were our representatives unable to suggest or arrange settlements to the satisfaction of the parties to the dispute. These 447 cases settled were nearly all adjusted through conferences arranged by the Commissioners. And when so adjusted the parties at interest had a new idea or concept of the value of a fair settlement. More than four hundred thousand workers were involved in the cases adjusted.

I believe you will agree with me that the activities of the Federal Government as a proponent of "peace in industry" and the success of the Federal Conciliation Service and of the state agencies have done much to promote peace and good will and increase the mutual respect and forebearance so essential in the industrial world.

As a matter of fact, American industry has grown so rapidly during the past century and a half that it gave to many the fear that commercial and industrial development would outstrip social development, for upon the latter depends the peace and happiness of mankind. Without peace, it matters not how prosperous or how wealthy a man or nation may become. From waterpower to crude machine processes was a tremendous jump. It called for the reorganization of the social structure of industry. From "home work" to "factory work" was a great change in the very life of the people. Consider if you will Elias Howe's first sewing machine first used in home work; and then look upon the giant textile machines and factories of today, and you will readily comprehend the great mechanical changes that made necessary the progressive social changes in the lives of the people.

And today, with the great majority of our population working the year through in field, factory, mine and mill in diversified occupations, from the humblest worker to the most skilled in the mechanical arts and trades, and with all of the people making up the bulk of the consumers dependent upon some or all of their activities for the output, it becomes evident that the friendship and contentment of the worker and employer is much to be desired if we are to enjoy the fullest measure of prosperity from our great production machinery. We can not expect to see absolute peace obtained at all times in industry; differences are bound to arise. To meet and to solve these misunderstandings, without loss of production or temper, has been the aim of the United States Conciliation Service and of the various state agencies. In the more than 500 cases to which I called your attention, I need not tell you that the Secretary of Labor was personally active, not only in handling some of the trade disputes that have been presented for settlement, but in advising and approving the recommendations of the director and Commissioners. In many cases the Secretary participated and sat in to advise in close deliberations with the interested parties.

The builders of American business enterprises are to be thanked for the energy, effort and money which they have invested in industry; and the American worker, than whom there is no more efficient, productive nor better paid workman in the world, is to be commended for his skill and application to the task of producing goods. The states and the Nation may well take seriously the importance of the maintenance of the spirit of cooperation existing between these two groups largely responsible for the tremendous prosperity in the country today.

A happy, well-paid contented worker means efficiency on the job; coupled with efficient management, this means satisfactory production for the buyer of labor and man-power.

In recognition of this relationship, the representatives of the Conciliation Service strive day in and day out to bring these two groups into closer relationship industrially. We feel that our whole social and industrial life depends largely upon amicable labor relationships, since the great bulk of the Nation's people is affected by some phase of labor life. The general public, too depends upon these two groups, and their attitude towards industrial peace.

Motives other than those of opposition and antagonism should be stimulated in employers and workers; cooperation and good will should be the objective of both, and yet it must be remembered that the hardest contested cases are often settled amicably and a better feeling brought about.

It has been the desire of the Secretary and the Conciliation staff to develop a service which would be of genuine help and assistance to all the industrial interests. The representatives of this Service have become expert in this field. Their previous experience and thorough understanding of men and issues, and of the industrial problems of management enable them, on being assigned to a trade dispute, to discern the material matters and throw aside all cloudy issues.

When a Federal representative succeeds in bringing about a meeting of the minds of the adverse parties through arranging a joint conference, and then through advice and suggestion, brings into open discussion and negotiation the specific issues involved, a settlement results, but far more important even than this is the extension of the spirit of good will and cooperation. This, my friends, is a far better procedure to follow than to use any compulsory methods, even if the use were possible.

We readily admit that the best type of conciliation is that which can be had between the directly interested parties, as a family matter, and without the presence or assistance of any outside agency. This, however, is frequently a difficult thing to bring about, especially when personal and group animosities creep into the deliberations. In these cases then it is possible for the Conciliation Service through its commissioners to use its good offices through mediation and to soften what might otherwise be a bitter and prolonged dispute.

Some one has said that tact is often more valuable than talent; and it is a proven fact that disputants who will not speak to each other will open their hearts to a disinterested neutral third party who is charged by law to give favor to none, but rather to give of his best judgment and advice in throwing the light of his experience and understanding upon the rights of each party involved.

In our work we labor to emphasize the fact that the conciliators are industrial peacemakers. They are without authority to make awards or issue mandatory instructions either to employes or employers. In fact, they merely put into play the wide knowledge which they themselves have gained in the world of industry, and offer ways, means, and alternatives which through long experience and diverse observations have been found to be solvents of serious difficulties in times gone by. The common ground of understanding which may prove a proper and just basis upon which to settle each difference is what the Department seeks to find and to present—not a persuasion against innate convictions or an influence for or against the complaint of either party.

Thus, as I have said, this policy, during the past years, has been found helpful time and time again; and the Department has been pleased to acknowledge hundreds of instances of approval of its policy on the part of both groups.

These statements are based on the practical experience of the Conciliators gathered through a period of 14 years of actual service. In that time 8,000 specific trade disputes have been handled by the Federal Conciliation Service, and many of these, carried as a single case,

involved many plants or operations. A record of approximately 87 percent of successful settlements was the result of the work of the commissioners. During that period, we cooperated with other agencies in nearly 800 cases.

Employers and employes constantly call on the representatives of this Service for advice concerning questions of industrial relationship or matters on which they hold divergent points of view. The trouble averted through the counsel of our commissioners in these instances is not set forth in our records.

The harmonious exchange of industrial opinion through official conciliation channels is becoming more and more to be recognized as the common sense way of adjusting labor controversies. The worker has discovered that he has a voice and a hearing in the submission to a joint conference of his point of view, and the employer has found that the plan of adjustment of the Federal Conciliation Service gives him full and free opportunity to set forth his side of the question in a meeting where both interests are assembled for the one purpose of settling a trade dispute. This exchange of knowledge on the part of each group is rapidly building up a splendid spirit of cooperation on the part of both employers and workers. The spirit of conciliation and cooperation is gradually but surely decreasing the number of strikes and threats of strikes. The Conciliation Service has reached out into virtually every area in the country with its message of mediation. The employers, employes and public are all convinced that frank, open consideration of differences arising in industry will bring peace into a situation torn with discord. We contemplate with satisfaction hundreds of cases where the ill feelings that years ago were sure to end in strikes and lockouts have in this day and age been assuaged by common sense methods.

Since there has been considerable discussion, during the past two or three years with regard to so-called Federal encroachment upon the rights of states to settle local problems, I consider it important to say to you that it has been the policy of the Federal Department of Labor and its Conciliation Service to act in close harmony with all state agencies, committees, citizens, or any unit which is engaged in ameliorating industrial differences. As a matter of fact, I might say that there is case after case in which the state and Federal conciliatory forces have jointly extended their services in trade disputes, and happy results have followed the joint efforts of the two units. The same is true as to private agencies which have had the ear of local disputes but which have needed to call for the broader experience and information of the Federal or state mediators obtained in similar cases elsewhere.

The Secretary of Labor is glad to exchange official courtesies in industrial mediation whenever it is desirable. In fact there are many cases which could not well be handled otherwise. The state representative is frequently much more familiar with local conditions and local issues, while on the other hand, the Federal conciliation has the opportunity of more extensive knowledge in other states in similar industries and of the desires and results obtained from a broader field extending through many states.

I am pleased to say that this attitude of cooperation extends generally and is growing in strength and teamwork. And if it does not exist in any state of which you may be informed, upon word from you the Secretary of Labor will be glad to enter into an informal understanding with the mediation or conciliation forces of the industrial department of any commonwealth, by which reciprocal activities in matters of grave industrial concern may be worked out by the state and Federal governments. Our desire is to strengthen the public regard for joint settlements of trade disputes through effective conciliation—not to shake the confidence of any one in the bond of governmental fellowship and its fairness to all concerned .

We have a firm belief based upon past precedents that the earnestly-desired and sincere type of conciliation as practiced by the Federal and state departments of labor will tend to lessen industrial misery, economic ills, and public discontent.

After 14 years on the job, we are convinced that industrial enterprises are experiencing less strife and ill will. We know that the common interests of the labor and of the employer groups in production are too closely interwoven to permit either one to become so adamant that they will not listen to reason. The idea of closer cooperation industrially is now pervading both groups. Each is necessary to the other. Each is the complement of the other. Their interests in production travel in the same direction. The preservation of this idea is merely good will and mutual respect in another form. And this is that for which we are striving—not independently, but cooperatively—as spokes of the great American wheel of progress. The Nation is the hub. The rim is the Federal and state governments, building together all the parts and enabling the Nation to roll on its way to a greater place in the great world of brotherhood, industry, good will and permanent peace.

PRODUCTION OF ALUMINUM IN 1926

THE value of new aluminum produced in the United States during 1926 was $36,583,000, an increase of less than half of 1 percent as compared with 1925, according to a statement prepared by J. M. Hill, of the Bureau of Mines. Virgin aluminum of 99 percent grade was quoted at 28 cents a pound until the middle of July, when a decrease to 27 cents to 28 cents was recorded, which was lowered to 27 cents the first of September, which level was maintained to the end of the year. The 98 percent grade was quoted throughout the year at 27 cents a pound. Aluminum bronze powder, as a paint pigment, and aluminum foil were used in increasing amounts. Manufacture of aluminum furniture was further developed during 1926. The electrical industry continued to consume large quantities of the metal, but the automobile industry remained the largest consuming industry.

Imports ("general") of aluminum metal, scrap, and alloy in 1926 increased over 72 percent as compared with 1925, reaching a total of 74,878,767 pounds, valued at $17,107,690, in 1926. Imports of plates, sheets, and bars increased 24 percent, amounting to 127,202 pounds, valued at $36,776, in 1926. Hollow ware imports in 1926 totaled 215,265 pounds, valued at $99,458. Total imports of aluminum in 1925 were valued at $10,536,639 and in 1926 at $17,502,435.

Exports of aluminum ingots, scrap, and alloys in 1925 were 8,130,222 pounds, valued at $1,835,213, but in 1926 were only 586,749 pounds, valued at $137,980. The total exports of aluminum in 1925 were valued at $6,057,071 and in 1926 to $4,452,303.

An important event in the aluminum industry was the formation late in 1926 of a European Aluminum Cartel, composed of all the principal producers of Europe, including the French, English, German, and Swiss makers of aluminum. While the Italian firms are not nominally in the cartel, the trade believes their movements will probably be more or less in accord with the cartel, for they are largely controlled by companies in the agreement. It is estimated that the cartel controls about 47 percent of the total world producing capacity for a period of two years, the life of the present agreement. The prime object is said to be to develop markets and to attempt to lower prices so that consumption will increase.

World capacity to produce aluminum has been so greatly enlarged since the war that production has overrun consumption. There is little question, however, that with lower base price for the metal, the markets could be greatly expanded.

SAFETY IN COAL PRODUCTION

Industrial Safety Important Economic Problem—Workmen's Compensation Bill Approaches Two Hundred And Fifty Million Dollars Annually—Aside From Its Appeal From Humanitarian Standpoint, Safety Is Good Business

By W. L. ROBISON*

INDUSTRIAL safety is unquestionably one of the chief economic problems of the United States. It carries with it an appeal which is universal. There can be no one here present to whom this question is not of paramount importance. It makes no particular difference in the end whether you view it from a purely humanitarian standpoint or from one which is strictly selfish and economic. From either approach the problem is one in which you must be vitally interested. I can scarcely conceive of an employer of labor so callous as to willfully neglect to provide all proper safeguards for the protection of those who are serving him with their labor, and while a corporation is an abstract being in itself, nevertheless you must remember that the management of that corporation is composed of human beings to whom physical suffering and pain are keen realities. But, disregarding the humanitarian aspect of the problem, and looking at it purely from a commercial viewpoint, you must realize that since the passage of the various workmen's compensation acts every accident which incapacitates a workman not only loses you his working effort but requires you to compensate him for that effort the same as though it had been expended in your behalf. This involves a double loss to you. The prevention of accidents, therefore, is economically profitable. But not only to the employer of labor is prevention of accidents a matter of great interest. To the employe himself it is a matter of major and vital importance. He has even more at stake than his employer since his own physical and mental well being is involved and to him the consequences are very personal and sometimes irreparable.

Twenty thousand to twenty-five thousand persons are killed annually while in the course of their employment. Two million of us are suffering currently from non-fatal accidents of varying degree. Just pause to consider what that means in terms of suffering, of charities, of hospitals, of homes for orphaned children. Think what it means in terms of production delays, of injured organization morale and of increased cost of production. It is estimated that the workmen's compensation bill must approach $250,000,000 annually. To management the problem of industrial safety becomes a problem of efficiency, since whatever interferes with the stability of the working force creates industrial waste—an expense that adds to production cost.

With the general safety movement carrying this universal appeal to all classes of employers and all kinds of employes, it may well seem rather surprising that no well-organized movement for safety developed until comparatively recent years. To the iron and steel industry of the United States the credit is probably due for the first well-organized movement for safety in this country. The pioneer safety work conducted by the Association of Iron and Steel Electrical Engineers led to the development of a national humanitarian movement, which resulted in 1912 in the formation of the National Safety Council, an organization that today numbers more than 4,000 members and includes the majority of the large industrial organizations of the United States. The National Safety Council has conducted a well-organized and effective safety campaign throughout the country and has accomplished much in many industries looking toward prevention of accidents.

W. L. Robison

In this day of great mechanical achievements a plan of standardization of specifications for apparatus and materials, of dimensions of mechanical parts, methods of test, etc., has been devised as an easy and practical means of benefiting all users of machinery, supplies, methods, etc., by advising them the results of the experience of others. This work of standardization has been conducted through the cooperation of many industries and groups with the Committee on American Engineering Standards. Growing out of the use of many kinds of machines and based upon the experience of many in their use, standards of safety have developed as applied to various machines. The creation of these standardized safety codes is under the immediate advisory direction of a representative committee of experienced safety experts known as the Safety Code Correlating Committee. A large amount of work has been done in the preparation of safety codes by this committee. They have prepared safety codes for use in more than 40 different and specific instances. These cover such operations as the use of power presses, sawmill machinery, power-transmission apparatus, machine tools, rubber machinery, etc. Now comes the question of developing basic codes on mine safety. This question has been brought to the attention of the officers of this Congress, who have given it some consideration, but have taken no action upon the proposal. Dean Holbrook will tell you his idea about safety codes.

DEAN E. A. HOLBROOK, *School of Mines, State College, Pa.:*

"In practically every coal-mining state there are state laws to govern the miner's safety, health, and welfare underground. In every case these laws detail what *must* be done. They are, therefore, minimum requirements of safety. They do not state what *can* be done. In other words, they offer no guide and no set of standards for the operator, safety engineer or inspector who wishes to place his mine safety on a higher standard than that required by the state law.

"It has been charged that the movement toward higher standards and practices in mine safety is an attempt to force on the industry a Federal or universal Government code of mining safety laws together with Federal Government inspection. As I believe the states are able to make and administer their own mine safety laws, I am not in favor of any movement toward the National Government taking over the regulation and inspection of mines. Therefore I need not defend this charge. I do believe, however, that the wide variances in mine safety laws among the different and often neighboring states have no justification by actual mining conditions, and often are a confusion and a detriment to real safety. For example, in September, 1926,† John A. Garcia presented a paper before the A. I. M. & M. E. analyzing the state mining laws concerning ventilation, and bringing out the confusing phraseology, the variation in spacing crosscuts, numbers of men allowed on a split, impossibility of actually determining what is a 'dusty' or a 'gaseous' mine and many other amazing irregularities and reasonless handicaps.

"We all know that the same criticisms can be applied to many other sections of the various state mining laws and present safety regulations. I feel that much of this confusion has been caused by not having any generally accepted standards as guides for possible safety legislation.

"Since 1923 the Mining Correlating Committee of the American Engineering Standards Committee has been interesting itself in the formation of codes or recommended safety practices of the various features of coal mining.

"Under their procedure The American Mining Congress and the Bureau of Mines, as sponsors, have brought out 'A Set of Safety Rules for Installing and Using Electrical Equipment in Coal Mines,' and the A. I. M. & M. E. as sponsor has issued 'Recommended Standard Practices for Rock Dusting Coal Mines to Prevent Coal Dust Explosions.' The Mine Inspectors' Institute of America are working on 'Rules for the Handling and Use of Explosives Underground,' and (*Continued on page* 519)

* Youghiogheny & Cleveland Coal Co., Cleveland, Ohio.

† "State Coal Laws Concerning Ventilation," Mining & Metallurgy, September, 1926.

SAFETY FEATURES IN MECHANICAL MINING

Work Covers Both Advancing And Retreating—Intensive Supervision Of Mechanical Loading Under Bad Top Conditions Reduces Accidents—Rock Dusting And Sprinkling In Use—Goggles Required At The Face—Bonus Paid For Non-Accident Records

By W. D. BRENNAN*

I HAVE not very much to offer in connection with the subject assigned to me by the committee, due to the fact that experiments, to date, with mechanical loading, in our locality, have been so limited. Our experiments, however, have been confined to three types of loading equipment, viz:

Sectional belt conveyors.
Shaking conveyors.
Scraper loading equipment.

In connection with the use of the sectional belt conveyors, we have found that the equipment, as furnished by the manufacturers, woefully lacks proper guarding of gears, chains, etc., and had to be carefully remodeled almost immediately upon receipt. This was also true to some extent with the driving mechanism of the shaking conveyors, as the protection of the gears on the first ones was rather poor; however, we have lately purchased a drive that is practically enclosed. The loading mechanism of the scraper loaders is pretty well housed as received.

Two systems of mining have been developed in connection with our mechanical loading, one advancing and one retreating. In the retreating system, where the men are operating on a face exposed to the break of the gob, it is necessary to use special precaution to see that the roof is always carefully secured. Where machinery is operating under these conditions, it has been found advisable to stop everything occasionally to listen for working in the roof. With the larger number of men on a face than is usually employed, there is always more possibility of breaks occurring and not being heard. This is partly offset, however, by the fact that there is always a face boss in charge of the men, who gives special supervision to the general safety conditions as well as the operation of the loading equipment. In this connection, we might add that our experience shows that the usual loading and cutting of the coal is done at considerable saving, but that there is, with us, always a heavy expense for the dead work, which in a great many cases is done by the contract loaders without special pay.

While we are not operating and producing a very large amount of mechanically loaded coal, nevertheless we have found that the intensive supervision has kept the accidents down lower, on a tonnage basis, than the straight contract parts of our mines. We feel very much pleased with this feature, as we are working under rather difficult conditions with fairly bad top and with equipment where accidents can readily occur.

The ropes on the scraper loader create quite a hazard, as does also the pans flying off the idlers, in the case of the shaker conveyors.

Our past records show that machine runners on electric cutting machines are injured more frequently than any other class of men which we have working underground. Just why this is so, we have not been able to determine; however, the fact remains.

We make a practice of rock dusting our main hauling roads and cross entries fairly well to the working face and then sprinkling with water to keep down dust. We see very little difference in the possible accident hazard from either gas or dust explosions as between mechanical loading and the ordinary contract systems. Where it is necessary we have a large number of men shoveling onto conveyors, which keeps the sprinkling almost constantly at work, all coal being cut with water as the cutter bar wets down the "bug dust" pretty well so that the coal is shot onto a wet bed. Our ventilation control at the working end of long face retreating pillars has been easily handled to date by drawing the intake current of air along the face by means of line brattices.

Deviating a little from the general mechanical safety features to general safety lines, we have been putting on, during the past six months, quite an extensive campaign among our men, there being some 800 to 1,000 working underground, to endeavor to cut out or eliminate altogether accidents. About six months ago we started insisting that all men at the working faces wear goggles. Our eye accidents, owing to the fragibility of the coal, ran from two to five a month at that time, with a number of them quite serious. Since we have had the men wear goggles, 100 percent, we have only had two accidents since the 1st of January. We are now insisting on the men wearing a "hard-boiled" cap to see if we can not cut down on head accidents. In one of our metal mine branches, where they have been wearing hats of this type, they have practically eliminated head accidents from falls, and undoubtedly saved several lives so far this year.

One of the boot-and-shoe manufacturers is manufacturing a safety shoe, and also one of the rubber companies a rubber boot, both of which have hard caps. Our sales to men of this footwear is running in the neighborhood of 150 to 200 pairs a month, but to date we have no way of determining just what results are from this safety feature.

Personally, I am of the opinion that the entire safety movement hinges around the ability to sell to the men the idea that they must be on the lookout and take care of themselves, and have them interested and up on their toes at all times trying to avoid accidents.

We pay our foremen a bonus on the basis of 1,000-man shifts worked continuously without an accident, and find that this is a very material saving, as under the New Mexico compensation law we carry our own insurance. Compensation payments for the first quarter of 1926 were $5,106.15 as compared with $3,827.87 for the same period of 1927.

* General Manager, Stag Canon Fuel Co., Dawson, N. Mex.

CARNEGIE FELLOWSHIPS

In continuation of a program of scientific research in mining and metallurgy conducted jointly by the Carnegie Institute of Technology and the Pittsburgh station of the Bureau of Mines, 11 college graduates have been appointed to research fellowships for the coming year.

Six of the appointees, it is announced, will conduct their investigations in the field of metallurgy, and five will study problems in mining and utilization of fuels. Both the University of Washington and Lehigh University are represented by two appointments.

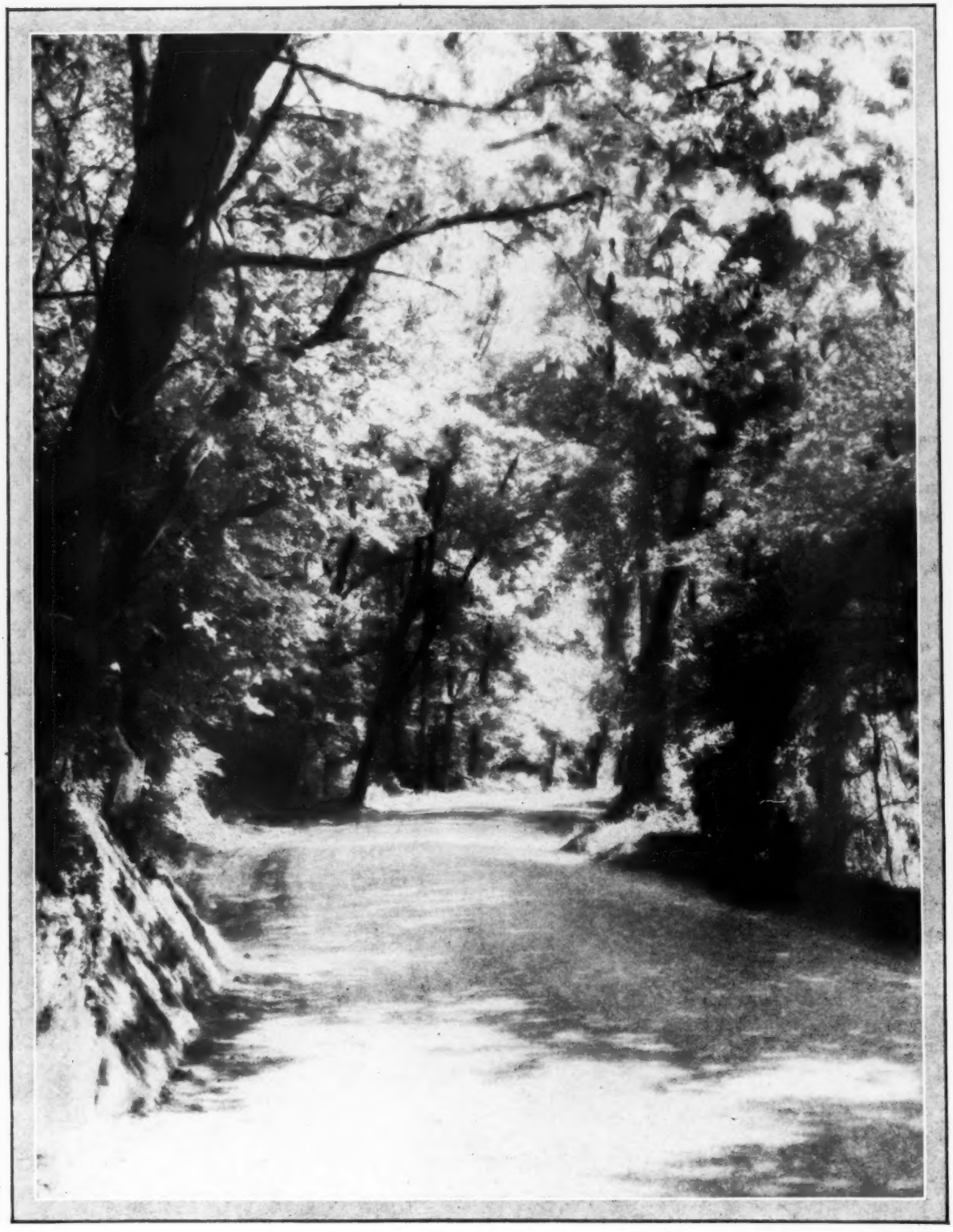
Appointments to mining fellowships were as follows: Harry A. Brown, B.S., chemical engineering, Lehigh University; Raymond C. Johnson, B.S., chemistry, Monmouth College; Harold M. Morris, A.B., chemistry, Cornell College; Robert N. Pollock, B.S., chemistry, and Donald L. Reed, B.S., chemical engineering, University of Washington.

Appointments to metallurgical fellowships were: John M. Byrns, B.S., metallurgical engineering, Case School of Applied Science; John F. Eckel, A.B., chemistry, University of Kansas; Hyman Freeman, B.S., engineering chemistry, Georgia School of Technology; Frank C. Norris, B.S., chemical engineering, University of Illinois; and Harold E. White, E.M., mining and metallurgy, Lehigh.

The research fellows will begin their studies on August 15 for a period of 10 months. Two advisory boards, one composed of mining engineers and operators and the other of metallurgical engineers and steel executives, will assist in selecting the problems for study. Each research fellow will conduct his studies under the direction of a senior investigator from the Bureau of Mines. At the completion of their studies, the research fellows will be eligible to receive the degree of master of science from the Carnegie Institute of Technology.

As in the past, it is planned, reports of the investigations to be made during the coming college year will be published in bulletin form for public distribution. Thirty-one bulletins reporting studies made under similar auspices during the past several years have already been published by Carnegie Tech, and the Bureau of Mines, and the Advisory Boards.

Studies to be made during the coming year will cover the origin and constitution of coal, coal mining, utilization of coal, mine safety, and physical chemistry of steel making.



In Rock Creek Park, Washington

"I do not own an inch of land
But all I see is mine"

BEST MEANS TO KEEP ACCIDENT PREVENTION BEFORE MEN

Accident Prevention Work Must Appeal—Sight And Personality Should Coordinate—Periodical Gatherings, Systematic Inspection And Regular Competition Essential—First Aid Packets As Incentive To First Aid And Rescue Training With Complete Records Encouraged

By CLYDE A. McDOWELL *

ACCIDENT means an event which was unexpected, or the cause of which was unforeseen. Prevention means to hinder, obstruct, or impede. Therefore, when we use the two words as in the subject of this paper, we are prompt to understand their true significance. We are attracted by the word accident, as it seems to strike us deeply in our everyday living. There is seldom a day goes by without our witnessing some form of accident, and the ever-thinking individual rarely notes or remembers of an accident but what he thinks of a prevention for that or similar accidents. Accident prevention should, therefore, be considered and possibly defined in part as "the unexpected thing" in the sense of having the preventatives put up in so many different ways and means that the individuals concerned will readily grasp them; that the attractiveness of the doses prescribed may be swallowed easily and the effectiveness observed by the unconscious repeating of said doses.

We are reminded daily of an excellent safety slogan, the three "A's"—"Accidents Are Avoidable." We see this slogan portrayed daily by automobiles whose radiator emblems glisten with these letters, which represent the American Automobile Association. It could be an emblematic symbol for us to adopt by linking these three letters together with but one objective—"Accidents Are Avoidable."

The value of a definite program and procedure must be considered on a basis of intelligence. This propaganda must be spread in such a manner that the effects of the principles to be considered should be correlated and entwined in a web, so to speak, in that the coordination and cooperation expected are noted in its entirety. It is a foregone conclusion that in the coal industrial activities our interpretation of the increasing phases of accident prevention problems must be fairly correct and conform to the ever increasing worldly intelligence, and probably the ever-increasing spread of our activities, which means that we must actually be a little ahead in progressive thought of the industrial problems of today.

A procedure that will appeal to the intelligent employe may not reach the other type. The method of reaching the so-called ignorant and "don't care" employe must also be different. It is then apparent that the means of prevention by usage of literature, posters, cards, lectures, etc., must be of such nature that it appeals to all classes, nationalities and creeds. This is indeed difficult, but has been successful.

When we consider that ways and means of preventing accidents must be clearly understood, willingly accepted and easily grasped by mixed nationalities, we can readily understand the difficulties encountered. The human element so considered must be reached and the propaganda so used, whether in personal contact, meetings, posters, or what not, must be so arranged that the sense of sight and personality have been appeased at a glance. If the people involved can grasp the idea quickly through the eye, a point of contact has been made that in time brings results.

There must first be a thought, a cause, and an inspiration for work of this kind. It must be so planned and definitely made a part of the industrial program by the directors of the industry, to be carried on as an integral and necessary place around the official table. It should be clearly understood that said industrial relations activities must have the proper financial and official support necessary to success. It must be especially considered that success can not be obtained in a short time. Success in this work may not even be noted on the surface, but the records kept so necessary for comparison will undoubtedly be on the right side.

It has been noticed in past years that an industry has made a bad selection when choosing the proper person to head-up its industrial relations activities, which means considerably more than the accident prevention program. It had been thought that the employe who had been with the industry for 30 or 40 years, and who had been a most efficient and faithful servant, was entitled to that position, inasmuch as there was little to do. A most glaring mistake, and yet the employe should undoubtedly be taken care of by the industry. It has also been thought that the young fellow just out of school and desiring to study the different phases of the industry would be the ideal leader. The error was still apparent. We have again encountered the superintendent, foreman, or other official who possessed exceptional ability in one line of endeavor who had been chosen as head of the department. Some men have excellent qualities, but possession of other essentials are indeed lacking. One may be well versed for lecturing and holding an audience spellbound with good and bad jokes, but lacks the art of personal contact with the men at their work, another may have wonderful tact for teaching first aid, but be inefficient in the teaching of mine rescue and kindred apparatus. Another may inspect a mine with perfect precision, make a wonderful report, but overlook the safety of the men he encountered. Another may have all the requisites of a successful safety man, but may not be qualified as an industrial leader, and may not have accident, turnover, compensation analysis and charts to substantiate even the accident prevention work. Another may be brought from some industry far removed from the one he is to enter.

It has been considered in late years that the successful program should be sponsored and led by a member of the organization. This man must be especially alert and one who has made all phases of the industry a part of his study. He should have executive ability, production experience, industrial leadership, a personal knowledge of facts, figures and analyses of compensation, relief and insurance, and pensions, an understanding of labor turnover analysis, and accident and other statistical records. He must know absolutely the characteristics of the men and their families; the class of labor encountered; a detailed knowledge of the industry, and from personal experience should be well acquainted with the every-day problems to be considered. It is imperative that he have a broad knowledge in first aid, rescue training and contests. He must be able to grasp new ideas for helping the officials and the men, to keep them keyed to activity at all times. He must be active in community welfare.

Cooperation and coordination of each and every employe is absolutely necessary for the success of this work, and this is also true for the success of the industry itself. To obtain this a successful operating and industrial relations' leader is secured, who has had extensive and successful years of experience. The plans are systematically made, but are extremely elastic as to certain phases of the work. At this time the official family, or key men, are acquainted with the program. It should be especially considered that the leader is vitally and interestingly concerned with every phase of the industry, and therefore should be thought of as a definite spoke in the official wheel for all problems considered. Why? There is no phase of an industrial organization but what concerns the moral and humane factors of said industry, whether it be an official or a mere employe.

Having established the standard for a complete understanding we continue through the official family until the superintendents, foremen, assistants, and all others acting in an official capacity are awake to the sense of the new life added to the organization. These are the backbone of any worth while organization, no matter what anyone says. They are the men who are confronted with intricate daily problems, a majority of which carry humane obligations, and therefore should receive our support and guidance immediately. They are the key to our personal contact. Therefore the understanding between the president and his official family, that they must do their part as an example for those employed by the company, means the beginning of a complete success.

The industrial relations and accident prevention movement should, then, establish a definite program as to periodical meetings: Meetings for superintendents, and departmental heads, where the general problems of the industry are considered; Superintendents, foremen and assistants' meetings, where the integral parts of their work are considered; Occupational meetings, such as haulage men, pumpers, shot firers, and others, where their particular problems, accidents, etc., are discussed; Employes' meetings at respective plants, where all phases of their home, recreational and mining problems are placed before them by pictures, entertainment, good short speakers, and literature, all of which

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are educational and instructive; Safety meetings at each plant where all employes are invited. At these meetings an organization is effected and nothing is discussed but ways and means of preventing accidents and receiving safety suggestions, which are acted upon at said meetings or referred to an efficiency committee. There should also be included in this group first aid, rescue, and advance rescue training classes. A Baloptican picture machine may be used to advantage at any of these meetings.

From these meetings we obtain our real active accident prevention work. I refer here to personal contact. In a sense officials are responsible for the safety of the men under their jurisdiction. We must then assume that all officials, or the entire official family, are the key men to the situations and circumstances at all times. Therefore as they are constantly meeting with the men at their working places several times daily, they have an exceptional opportunity to tell them the ways and means of preventing accidents while instructing them in their daily tasks. We are told that 90 percent of accidents causing injuries are due to carelessness, and the immediate thought is the carelessness on the part of the person injured, which may be true in a sense, but do not overlook the responsibility and probable careless attitude of the officials who visit this man daily of not helping him to help himself. We must assume, however, that in such a definite program, that the officials are on the job, have been instructed properly as to the humane manner of handling men, and then know the meaning and action necessary in handling such delicate situations and circumstances as confront them daily.

We must not overlook the fact that at the beginning of such a program a careful inspection should be made both inside and outside the mines, of mechanical and otherwise unsafe conditions, and they should be remedied at once. In this connection we have noted where a new broom swept especially clean, and a great deal of money was expended for proper and efficient guards for machinery, but after the broom had become worn somewhat it was noted that the expenditure was not appreciated. Why? The carelessness of the officials and employes was apparent, inasmuch as the guards would be removed for different reasons and found parked in obscure corners. Guards were purchased for a specific purpose and had their part in this program but were forgotten. Systematic recorded inspection is necessary.

First-aid and rescue-apparatus training must be included in such a program. First-aid classes should be started and every employe hold a Bureau of Mines first-aid certificate, and also a certificate from the company for class work. In addition, the company may issue another certificate for participation in contests. One company I know presents each employe who completes the class work and receives a certificate their own special adapted first-aid pocket packet. This packet is presented gratis to the individual for his interest in the prevention of accidents or proper care if an injury should occur anywhere. He is encouraged to treat injuries, no matter where they occur, whether in or about the mine, on the street, in the home, or elsewhere. Injury cards and material are kept convenient for distribution. Injury cards are filled in properly for any treatment, no matter how slight, and turned in for record, which will be mentioned later. There is no question but what such a percentum of first-aid men at all times, and their interest thereto, will help in accident prevention work. It seems that past experience will prove that the men so trained have unconsciously an affinity for accident prevention and results are obtained that are unnoticed on the surface, but an analysis proves, without doubt, that this has been one of the contributory causes. Interplant, state, school, and international first-aid contests should be encouraged.

First-aid training classes should be established in all high schools and probably in the higher grades of the elementary schools. At least Red Cross certificates should be distributed to all successful students. As a suggestion, first aid should be established as a credit in high-school work.

In connection with injury cards turned in for treatments rendered, either from the pocket packet or stationary first-aid stations, one company inaugurated successfully a National Safety Council Trip Contest. The superintendent, foreman and an employe other than an official were awarded a trip to the council meeting each year; the superintendent with the lowest severity rate (days lost per 1,000 hours worked), the foreman with the lowest frequency rate (number accidents per 1,000,000 hours worked), and the employe who received the highest number of points for meritorious first-aid treatments and safety suggestions. Each injury card had the O. K. of the superintendent or physician that the treatment had been made and points were awarded in accordance to a procedure and scale of credits and discounts by a committee of three, the chief medical director, the employes' commissioner, and the manager of the industrial relations department. In connection with the above, another group composed of assistant foremen, fire bosses, weighmasters, and outside foremen were based the same as the employe and the winner of the group was allowed 10 days' vacation with pay.

With the above procedure properly functioning and all employes having the knowledge for proper first-aid treatment, the installation of first-aid stations must be made. We believe stations should be more of the movable type; that is, cut a standard size hole in the rib of a certain section of the mine an average distance from the men in that section, in which is placed a wooden platform. Install lights and hang on two hooks a large canister containing a stretcher, two blankets (rubber and woolen), a complete set of splints, and a small cabinet containing first-aid material. This canister, which is really the station, may be carried or transported upon a motor and thereby literally take the station to the injured man, which in reality is where you need it.

Rescue-apparatus training is essential. Ten percent of the total number of employes at each plant should have the training and hold certificates issued by the United States Bureau of Mines. However, teams should be organized and especially trained in advanced training and recovery operations, which has been an added feature of the Bureau of Mines extension work. There should be printed and posted a procedure which shows the equipment and general directions in case of mine fire or explosion, and also a definite schedule of procedure in detail in case of mine fire or explosion. In addition to this, there should be a chart showing the employes designated for specific duties at the respective mines to cover the definite schedule or procedure in case of mine fire or explosion. Well-equipped rescue stations should be maintained in accordance to the size of the company.

Periodical inspections of the mines should be made for safety and efficiency and reported on a standard form. An inspector of a mine or division should be well versed in the general phases of mining problems and be qualified to report intelligently and efficiently. Naturally the phase of safety and the welfare of the men encountered would be seriously considered by him. One company has successfully held periodical inspections of so-called subjects at all mines and reported on special forms showing at a glance the number of safety infractions to a standard rule or law of that particular subject at the different mines. For example, the subjects might be motor headlights, gongs and trip lights, guard boards, guarding of pump and armature gears, couplings and belts, first-aid stations and equipment, telephones and signals, hoisting engines, cages, cables and signals, etc.

Most accidents should be investigated. One company has the inspector receive telephone preliminary report of accident, and he determines at once if same should be investigated. Probably a drawing is attached to the report of said accident with recommendations. In case of major accidents, a superintendent and foreman from another mine are brought in to help the inspector in his investigations with the superintendent, foreman and committee of the mine where the accident occurred. The recommendations made are broadcasted through the medium of all meetings and graphically explained on posters on bulletin boards.

An excellent help in following standard procedure would be the appointment of an efficiency committee. This committee would first make a complete study of the conditions encountered and then draw up definite standards to follow, accompanied where possible by drawings. After these standards were completed for all phases thought practical, then same should be published in small pamphlet form and copy furnished to each new employe. The committee should meet often to discuss and dispose of problems referred to it.

Night mining classes and trade schools should be established for our young men and boys who desire to advance in the industry. The night school mining classes especially for those who are working in the mines. The trade schools for our young boys in school who can take up certain phases at the shops and mines for definite study.

Accident prevention work can be especially broadcasted to the men through the schools. This plan has been found to be successful. Interest the school in joining the National Safety Council, have first-aid classes and contests, procure safety-motion pictures and literature as prescribed by the council and other worth while organizations. As often as the opportunity presents itself, lecture to the students in the school. Have boy and girl scout organizations.

The work can not be successfully carried on without a systematic method of employment and the accurate keeping of turn-over records. Where practical, all employes should have medical examina-

tion, and employment cards record a follow-up of his record with the company. Turn-over analysis and charts should be compiled by plants. A study made of the terminations and followed closely. These records enable studies of occupational deficiencies on account of age, deformities, sight, etc. Turn-over is a worth-while study.

The morale of the employes is affected considerably through the compensation, relief and pensions, which, in part, reverts to accident prevention. All employes injured should be followed through by frequent hospital and home visits, remembering the injured by papers, magazines, smokes, etc., and then, when they are able to return to work, their occupations should be considered for their physical welfare. The medical department can cooperate wonderfully in this follow-up work. The cooperation of this department is indispensable in accident prevention work.

One company was able to make rapid progress by cooperating with the employes' committee of each mine, who were elected yearly through a working agreement between the company and its employes. These committees were instrumental in various ways of putting across cooperative programs. It was found advantageous to occasionally have this committee make an inspection of a mine and at the same time visit each working place and talk accident prevention to the men. Committees may be selected in various ways and are, no doubt, worth while.

A bulletin service is indeed necessary to successful accident prevention. The National Safety Council has a very attractive bulletin service included in their industrial membership. A bulletin service requires first, however, attractive and electric lighted bulletin boards placed at conspicuous points both inside and outside the mines, and should be so placed that employes will pass them often. In addition to the above service, a company should occasionally post their own bulletins referring to specific cases with drawings. A successful periodical bulletin should show the name of employe injured, cause, extent of injury and the carelessness attributed to it. It should also give striking, snappy safety reminders as to what we should and should not do.

The National Safety Council Service also includes the "Safety News," a monthly publication, which is especially helpful to circulate to the superintendents and foremen.

All manner of accident prevention standard signs should be posted. Warning and caution signs should be used. Electric signs are helpful. I have in mind a large electric sign, "Safety First," which confronts every man as he steps off the cage at the bottom of a 425-foot shaft and starts for his working place.

I believe the day is not far distant when every mine will be using the electric cap lamp, permissible powder and electric detonators. I know of one large mine on this basis which is now working on its eighth year, and by accurate records there has not been an injury of any kind due to explosives.

Rock dusting is essential, but should only be used where systematic dusting and sampling is carried on.

I understand a bonus system to key men in the industry for accident prevention work has been successful. I would be more inclined to favor such a system if it included increase of production, material cost, turnover, production cost, general safety conditions and first aid and rescue men—a definite number of points according to the importance allotted to each subject, but the total to be considered on a 100-point basis.

All worth-while literature that can be obtained should be distributed to the employes. The Bureau of Mines publish some very helpful pamphlets for the mining industry and they should be placed before the men. Many insurance companies, the National Safety Council, powder companies, and others, publish helpful booklets. Many of our mining institutes could probably publish, with a little help, certain papers which could be appropriately distributed to all classes of mining men.

One company uses this unique method of helping the cause: When an accident is investigated and the injured man or some one else did not observe the rules, and caused said accident, or if any employe, whether official or others, disobeyed the mining law or standard rules, an "Always Be Careful" card is made up showing the mine number, check, name, place of accident, or observation, a description of what happened or was observed, and what the result was or may have been. This card is signed and placed in his pay envelope on the next pay day. The employes endeavor to keep these out of their pay envelopes.

Attractive cards with an appropriate message, wired to mine cars and motors over a definite period, has proven successful in reducing the heavy toll of accidents.

Small pay envelope activity cards with a specific, brief message is worth-while propaganda. This is an excellent way to awaken the employes to the prevention medicine where a major accident has occurred.

Appropriate, short, snappy safety reminders should be rubber stamped or printed upon the pay envelopes, pay statements, time sheets, weighmaster sheets, relief and compensation checks and vouchers, and even letterheads and envelopes. These should be changed periodically.

New ideas must be gathered from outside sources by attendance at meetings of this type—the National Safety Council, mining institutes, first-aid contests, etc. It is naturally understood that the mere attendance at such meetings is not sufficient, but that one should be inspired and return to his work with renewed interest.

In order to make a close study of accident prevention work and graphically illustrate the accomplishments by mines as a periodical comparison it is necessary to have systematic statistics. Accidents should be studied from every angle possible, and then, as a spider weaves a web, so should statistics weave themselves so systematically and coordinately that results would be noticed in time by whatever comparison desired. One company has adopted the following forms for a study of this kind: Accident analysis, summary of accidents, nationalities of employes, summary classification of nationalities of employes, accident analysis by plants, causes of fatal and non-fatal accidents, ages of employes, terms of experience, fatal and non-fatal accidents as to hours of occurrence, percentum of accidents by hours through actual producing periods, percentum of all accidents as to severity and natural deaths, inside and outside accidents, comparison fatality rate of United States, State of Pennsylvania, bituminous field of Pennsylvania, State of West Virginia and that company, number of weeks lost per non-fatal accident, by mines, fatal and non-fatal accidents by days of week, first-aid analysis, comparison as to frequency and severity rates, and compensation paid for injuries. On each of these yearly reports is shown the record for the current year as compared with the previous year, and also the completed record of the same information for the entire period of their activities, all shown by number of accidents and in percentum basis. Charts are used for many of the above forms.

Nothing must shake our confidence in this work. I heard a noted athlete lecture recently. He said that the biggest word he knew today was "pep," and that it could be used to advantage in expressing the true significance of what should be kept in mind and what could be accomplished in any worth-while endeavor. The first letter of this word stood for "purpose," which is especially attractive to those in accident prevention work. The second letter stood for "enthusiasm," which must be apparent at all times, and the third letter stood for "perseverance," which we surely need in our endeavor. We surely need this word "pep" as above defined for our constant guide to keep accident prevention before the men.

The chairman of the Cunard Steamship Co., whose oil fuel bill is said to be larger than that of the British Admiralty, in recently discussing the bunkering of liners, stated that the cost of fuel oil at present does not compare favorably with the cost of coal, but against the actual cost price there are many advantages to be considered. There are limits to the price which the company can afford to pay and it is possible that if the price of oil continues to rise the company will seriously consider reversion, for a part of the fleet at least, to the use of coal.

Since 1913 the world tonnage of vessels fitted for burning oil fuel has increased from 1.3 million tons to 18.2 million tons, and it is chiefly on account of this great expansion in the supply of oil burning steamers that the quantity of coal shipped at British ports as bunkers has declined from 21 million tons to 18 million tons, notwithstanding an increase in the same period of 17 million tons in the gross tonnage of steamers and motorships.

Early in April best South Wales steam coals were selling at $4.62 a ton f. o. b. while fuel oil at British ports was selling at $19.44 a ton. A statement was made before the British Coal Commission in 1925 that coal was at a competitive price when selling at $11.76 a ton compared with $17.62 a ton for oil fuel.

The tonnage of vessels now building in the world which are to be fitted with internal combustion engines is 1,172,178 tons while the tonnage of steam vessels under construction is 1,370,490 tons.

SAFETY IN MINES

Discipline Is First Requisite—All Units Of The Company Must Be Completely Sold On The Safety Idea—A Definite Set Of Safety Rules Must Be Established And Strictly Adhered To By Both Employe And Official

By EDWARD GRAFF*

THE safety problem in connection with coal mining should receive the first consideration, and I believe is receiving first consideration with many coal-mining companies; some of these companies have made great strides in the safety movement and have made a decided reduction in the number of accidents. Other companies that have been just as energetic in the movement of safety have not made the reduction in number of accidents as their efforts warrant. No doubt the general physical conditions of the mine have a great deal to do with accident reductions.

In some mines where the coal is from 6 to 8 ft. thick, roof good, entries from 12 to 16 ft. wide, clean from rib to rib, you would wonder why they should have accidents; while another mine where the coal is 3 to 4 ft. thick, roof conditions bad, entries 10 to 11 ft. wide, and continual trouble in keeping them clean of falls, notwithstanding the fact that this company may be doing as much, if not more, toward trying to reduce accidents than the other company, does not make the progress it should make.

The employes, as a whole, are willing to cooperate in the safety movement, and if a very careful survey of the industry should be made I am inclined to think that a great many of the officials in the mine are among the offenders of the state laws and company rules. When this condition exists, it is a certain fact that, if the men in the mine see their boss jumping on a moving trip, riding on a locomotive, allow company men to carry powder in the mine in paper packages in excess quantities, or any other violation, they get in the same spirit and the safety movement is sure to take a slide.

Therefore discipline is the first requisite.

The mine foreman in taking charge of a mine should be sure to carry out all of the laws of the state and company rules. He should study his men and get their confidence. He should pay what he promises to pay, and if he is unable to pay a certain price for a certain piece of work he should say so rather than leave the workman under the impression that he is going to get something and later find that he does not.

The section foremen or fire bosses should see that they carry out the state laws and company rules pertaining to their work, and if they do this they will have no trouble carrying the safety movement on to the other workmen. They must see that the places on their section are driven according to the rules of the company, the ventilation taken care of, roadways kept clean, as they should be in charge of their particular section and directly under the supervision of the mine foreman.

There should be a set of rules adopted by each company and these rules should cover all phases of mining and each occupation inside or outside of the mine. If the employes see that all officials carry out the state laws and the rules of their company they will endeavor to carry out the rules pertaining to their particular work.

Beginning with the superintendent: he should be sober and of good moral character; he should stand high in the esteem of the whole community; he should be explicit in his instructions, cordial to all, candid in his opinion and be willing to hear both sides of any controversy. He should be the outstanding figure in any and all movements, safety or otherwise, comply with all rules and laws and see that the other officials do likewise.

The mine foreman should have full charge of the inside of the mine and directly under the supervision of the superintendent; he should be sober, of good moral character, and willing to take instructions from his superior officers; he should have the same characteristics as the superintendent; he should comply with all state laws and rules of the company; see that all entries and rooms are driven as required; clearance along roadways; roadways kept free from dust, fine coal or debris; trolley or feeder wire properly hung, wires properly guarded, refuge holes where required; proper timbering; sidetrack so located to give service to the miners in sufficient empties, and proper timber supply. He should visit all working places at least twice each week to see that all places are safe and being worked as required. These are only a few of the rules that should apply to the foreman.

The section foreman is really the mine foreman on his particular section, and should carry out all instructions given him by his superior, the mine foreman. He should be sober and of good moral character and should pay particular attention to the condition at the working face; he should visit each workman twice a day if possible, see that timbers are properly set, dangerous slate taken down, and instruct the workman with reference to his work. In a great many cases the section foreman pays more attention to getting cars loaded than he does to safety, and I have found that in some cases he visits the workman and notices nothing but the loaded car, and it is often the case that an accident occurs about ten minutes after he leaves the workman's place.

The fire boss, in making an examination of gaseous mine in the morning, should not only examine for gas, but he should pay particular attention to the ventilation and the condition of each workman's place, and if danger exists, such as loose slate, no timber, or any other danger, he should immediately fence off the place and not allow the workman to enter until he or some other official goes back in the mine with the workman and stays with him until the danger is removed. A great many accidents occur by telling the man to go to the place, remove the danger board and take down the slate or remove the danger before starting work, and possibly the official may not visit the workman's place to see that the danger was removed. These conditions lead to carelessness.

The mining machine operator should examine his working place, before starting to cut coal, and should not cut the place if any danger exists. He should not allow any person near the machine while starting to cut coal, as jacks may give way, allowing machine to swing around and injure them; he should see that bit guards are in place, especially when tramming from one place to another; he should not move machine across face after he has finished cutting unless clutch is removed to prevent the chain from operating. He should not leave his machine with nips on feeder wire as power on cable may short-circuit and cause fire along roadway. If he notices any defect in the equipment he is operating he should notify the foreman at once and have it repaired. These few items and many others should be explained to the operator and, if carried out, will help reduce accidents to a minimum.

The motorman should be careful in handling his trips at all times, be sure of proper signal before moving trip, allow no person to ride on motor nor on mine cars unless it is a special man trip, not coast down hill with trolley pole off wire, keep safe distance between locomotives when traveling in and out of the mine, allow no back poling of locomotive, or sliding of head hook along wire; see that there is sufficient sand in sand box of locomotive; see that brakeman uses trip light, and drag where necessary. He should not couple cars while in motion, make flying switches, nor bump mine doors open with locomotive. If there is no trapper at the door, he should stop the locomotive and get off to open the door or wait until the brakeman opens it. These and many other rules should be explained to each motorman, and I am sure he will endeavor to carry them out if he sees other officials and employes carrying out the rules pertaining to their work.

The pumper should stop pump when oiling or working on pump, and not allow oily waste or other inflammable material to lay around the pump room. Oily waste should be kept in receptacles for that purpose.

The electrician should see that all switching equipment is properly installed, wire properly hung, proper guards, bonding, etc., and allow no machine to operate if in need of repair. He should be directly under the mine foreman's supervision and should see that machine operators, pumpers and locomotive operators comply with the rules and state laws.

Every miner or workman should each day before beginning work examine his working place, take down all dangerous slate or otherwise make the place safe before proceeding with his work; he should observe every precaution to prevent accidents inside, outside or about the mines; fire no more than one shot at a time in any place, and not use more than one (*Continued on page* 519)

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IMPROVING MINE SAFETY THROUGH CONFERENCE ON IMPROVED FOREMANSHIP

Humanitarian Forethought Yields By-Product Dividends—Development Of Leaders Sought—Personal Relationship Emphasized—Reaction Brings Diversified Reading and Better Citizenship—Conferences Automatically Advance Mine Safety And Accident Prevention

By J. D. ROGERS *

IN the beginning, I am going to assume that all mining men are intensely interested in the prevention of accidents in the coal mining industry. I am sure also, that the chief interest is from a humanitarian standpoint and not from a monetary point of view. The former may be stated as the major idea, but it is a well known fact that the latter is an indirect result, or it might be called a by-product.

The conference idea did not originate with the Stonega Coke & Coal Co., but probably was a direct result of post war conditions, at which time so many men were released from military duties without having been trained for any specific trade except fighting.

The objectives of conference work in the mining industry are many, but a few of them may be summarized as follows:

(a) To assist in the better understanding of human relationship in the industry.

(b) To the developing of better cooperation.

(c) To enable the worker to see the colliery as a whole and appreciate his place in it.

(d) To prepare himself for a place of greater responsibility when opportunity offers.

(e) To increase quality and quantity of product.

(f) To promote safety and accident prevention.

It is the latter objective to which I wish to call your particular attention in as few words as possible.

About six years ago Mr. J. C. Wright, who then represented the Virginia State Board for Vocational Education, began his mine conference work in Southern Virginia at Norton. This conference on improved foremanship was sponsored by the Virginia Coal Operators Association, in cooperation with the Virginia State Board and the Federal Board for Vocational Education. This conference was a general one, covering the entire coal producing area in Virginia, and to this conference the Stonega Company sent eight of its most representative mine foremen. The enthusiasm shown by the members of the conference appeared to be so genuine and the opportunities for improvement seemed to be so apparent that it was decided by the Stonega Company officials to extend the conference idea specificially to their individual collieries.

With this idea in view, the services of Mr. J. C. Wright were secured and from November 28 to December 17, 1921, he conducted two improved foremanship conferences, consisting entirely of Stonega Company employes. The first of these two conferences included only colliery superintendents, the safety engineer, and representative members of the Engineering Department. The second included foremen and assistant foremen from all the collieries who had not had the privilege of attending the original improved foremanship conference previously held at Norton, Va.

The primary idea of these two conferences was to develop leaders to hold similar conferences at each colliery as opportunity offered, so that opportunity might be given to the colliery workers to take advantage of the information at hand. The direct result of this plan was that six separate colliery conferences were held during the following year, at which approximately 600 men participated to the extent necessary to receive a certificate on improved foremanship from the State Board of Vocational Education.

This conference idea made it possible for the officials of the company to get in closer touch with the employes and in many instances catch their view point from an angle possibly not previously considered. It also gave the employes a feeling that they really belonged to the organization and that the company interests and their interests were mutual. In many instances, the possibility of leadership was discovered in certain members of the conference where it was least expected, which later was tried out and has since proven to be real. It is quite probable that without this chance for expression some of these men would still be working for a daily wage, without having had the chance to prove their latent ability.

The conference idea has also unquestionably reacted on the members in another form, in that it has broadened them to the point where they have become better citizens and members of their respective communities. It has increased their store of knowledge and in most instances given them a desire to diversify their reading. It is probable that there was a certain percentage of attendance due entirely to the request of the superintendent, but, I wish to state emphatically that no strong arm methods were used to secure attendance at the meetings. Five evening meetings a week for three weeks were held, and the attendance of each member necessary to secure a certificate was 80 percent. In other words, he could be present at 12 of the 15 meetings and still quality for his certificate. It was in this manner only that the idea could be brought to the greatest number of colliery workers.

Each colliery conference was closed with a banquet at which all who had received certificates were present. In addition to these, the company officials and other invited guests helped to make the evening a success.

The results secured have been most gratifying, and as we look back over the few years which have intervened since the conferences for colliery workers were held, the very apparent benefits have more than warranted the small initial expense and effort.

In October, 1926, a similar conference was held which included only members of our retail stores' organization. The personnel of this group, probably having on the average a higher standard of mentality, greater results could be expected. It is the concensus of opinion among the company officials that unquestionably the results have been more apparent and lasting. The spirit of business courtesy and willingness to serve, with the desire to please, is most noticeable to a casual observer. When service of that nature is rendered, there can be no question as to what the results will be. Permit me to say that the experiment has already given returns beyond the expectations of those who fostered the movement.

To continue to train men needs specially trained leaders to carry on this work. In order that the situation might be met a conference was completed at Norton, Va., in March of this year, entitled, "Teachers Training Class in Mine Safety and Accident Prevention." This work was sponsored by the Virginia Coal Operators Association and was conducted by the Virginia Department of Vocational Education and the United States Bureau of Mines.

To this conference the different operators in the field sent men most suited to become teachers and leaders in accident prevention at their respective collieries. This course required 90 hours of actual attendance and lasted over a period of three weeks. The leaders of the conference were Mr. D. M. Barum, of the Virginia Vocational Department and Edward Graff, Mining Engineer in charge of the Norton rescue station of the Bureau of Mines. It is our understanding that this is the first conference of this nature ever held by the bituminous coal industry in the United States.

The class consisted of 23 men from the Virginia collieries, of which several were Stonega Company employes. Particular care was taken on the part of the Stonega Company to select representative men from different collieries who were considered to be especially adapted to become teachers and leaders in conference work along the lines of safety and accident prevention upon their return to their respective collieries. It is not necessary for me to go into details regarding the instruction given to the class by the Messrs. Barum and Graff, as you gentlemen are perfectly familiar with mining conditions and what mine safety means.

I might add however, that special emphasis was laid on the construction and uses of the safety lamp and its place in the mining industry as a safety measure. The various kinds of approved mine rescue apparatus were carefully studied and their application made plain to members of the conference. The question of explosives was fully covered, in so far as it applied to safety measures and accident prevention. At all times the leaders had in mind that they were dealing with men who were later to take the place of teacher in their respective colliery com- (*Continued on page* 519)

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WHEN AND HOW TO UNSEAL COAL MINE FIRES[1]

Each Fire An Original Problem—Five Methods Of Extinguishment—Factors Governing Unsealing—Requirements In Organization For This Purpose—Rock Dust Barriers Recommended—Famous Fires Recounted With Results Attained

By J. J. Forbes[2]

MINE fires are an ever-present hazard; in fact, they are one of the greatest hazards in the operation of mines. They have taken in their wake a tremendous toll in lives and have occasioned untold property damage. The destruction of life and property, and demoralization and disorganization which frequently accompany mine fires make their occurrence greatly to be dreaded by mining organizations. No fixed rule can be laid down for the control and extinguishment of all mine fires, for each fire presents in itself a more or less original problem dependent on the conditions encountered. The principal causes of mine fires briefly stated are: Open lights, smoking, defective wiring and electrical installations, ignition of gas, blasting (especially when done with black powder), incendiarism, and spontaneous combustion. The primary object is to prevent fires from occurring by eliminating every possible fire hazard.

Methods of Fighting Fires

Despite the precautions we may take to prevent fires, we must be prepared to handle them should they occur. The usual methods for control or extinguishment are: (1) Direct attack with water, chemicals, rock-dust or sand; (2) flooding the mine or affected area; (3) enclosing fire area with tight seals; (4) flushing enclosed fire area with silt or other solids; and (5) introducing into the fire area inert gases such as carbon dioxide (CO_2). A large number of mine fires are extinguished in their incipiency by direct attack, and failure to extinguish by this method is generally due to late discovery, lack of water, and other essential facilities or improper procedure in the initial attack. In the event of failure to quench the fire in its incipiency, one of the other methods of control or extinguishment is resorted to, excepting the use of inert gases which is expensive, laborious, and very often unsuccessful. The most practical method used for control and extinguishment is sealing the mine or affected area, thereby excluding air and gradually extinguishing the fire through lack of oxygen to support combustion. No attempt will be made to discuss the proper procedure to use in sealing mine fires, because this subject was ably presented by J. T. Ryan[3], at the last annual convention of this Congress.

When to Unseal Mine Fires

The question of when and how to unseal mine fires is of vital importance to the mining industry. If an error is made by unsealing a fire area too soon, the hazard to life and property is always increased. This dangerous practice has happened and seemingly continues to happen with unusual frequency, with the resultant loss of life and other enormous economic losses. The premature opening of sealed mine fires is most frequently caused through lack of knowledge of the inherent danger involved and the extreme eagerness to restore the sealed area to a production basis. In the preparation of this paper it was disclosed that State Mining Laws and other mining authorities give very little advanced information that would adequately direct those who have been confronted with this problem. This condition can be largely attributed to the failure of mining men in the past to give this problem the consideration its importance merits. The control of fires by sealing and the time for unsealing are based on established laws of physics and chemistry, coupled with experience and sound judgment of surrounding circumstances. Through the aid of the experienced chemist versed in the technique and interpretation of fire gases in sealed areas, we are provided with a reasonably accurate knowledge of the composition of the fire gases, and hence are able to determine the potential hazard involved and the time the seals can be broken with the least possible hazard.

Next in importance to the determination of the time for unsealing, is that of perfecting an efficient organization and making ample provision for the necessary equipment and materials for the use of those who are to engage in this hazardous undertaking.

Factors Governing Time for Unsealing

The unsealing of any mine fire is a hazardous undertaking and should not be treated lightly by those engaged in the work. It matters little whether the mine is rated as gassy or non-gassy; fires should all be considered as highly potential hazards when the time arrives for unsealing them. Besides the proper time for the unsealing, which should be carefully considered, every possible safeguard should be placed around those engaged in the work.

Experience and scientific study have taught us that no attempt should be made to unseal a mine fire until the oxygen content of the sealed atmosphere is sufficiently low to make explosions impossible, irrespective of the amount of combustible gases that may be present, and also not until the carbon monoxide (CO), which is the indicator of combustion, has disappeared. In addition, sufficient time should be given for the area under seal to cool in order to minimize the chance of rekindling when air is admitted for the recovery of the affected region. In substance, some of the principal factors that govern the time for unsealing fire areas as gained from personal experience, observation and through consultation with mining men experienced and conversant with this subject, briefly stated, are: (1) Extent of fire under seal; (2) character or kind of material involved; (3) characteristics of overlying strata and its likelihood to cave and cover the fire; (4) tightness of seals and enclosed area; (5) influence of barometric pressure on the enclosed area; (6) accurate and systematic sampling of the atmosphere under seal; (7) composition of fire gases in the sealed area; and (8) location of the fire area with respect to ventilation.

Effect of Boreholes, Area Sealed, Intensity of Fire, Roof Material, and Caving

In addition to the factors just mentioned, which generally govern the time for unsealing, there may be local factors that will necessitate careful scrutiny such as proximity of gas wells to fire areas and position of boreholes. Ordinarily a large acreage under seal will require more time before unsealing than a smaller area; especially is this true if the seals in the former are poorly placed in the sealing operation. The size and intensity of the fire at the time of sealing are factors which should be taken into consideration in the reduction of oxygen content of the sealed area. The character of the strata overlying the coal bed plays a very important part in determining the time for unsealing. For example: an oily shale roof that has presumably covered a fire will burn and retain heat for long periods, even after the oxygen content of the sealed area is reduced to a point where combustion is impossible. The writer knows of instances where roof of this character was hot 30 days after the oxygen content of the fire area had been reduced below 3 percent. The likelihood of re-kindling on the admission of air under these conditions is considerably augmented; furthermore, it is extremely difficult to get to the seat of the fire for long periods where the roof has caved and covered the fire, and is of a combustible nature. Another striking example where caved roof materials of a combustible nature aggravates the fire under seal is where the immediate roof over the coal is composed of alternate bands of bone, shale and coal, the bone of which is fairly high in sulphur.

The characteristics of the material burning—that is, whether it is wood, various kinds of bituminous coal or anthracite, rate of burning and change of gas composition—are factors which may influence rekindling on the admission of air. Coals that run high in volatile combustible matter would burn faster and be more likely to rekindle on the admission of air than coals or material low in volatile-combustible matter.

Tightness and Material of Seals

Tight seals are essential for oxygen control. Preferably they should be made of non-combustible material such as brick, tile, concrete, etc., well hitched into ribs, floor, and roof. They should be built at a point where the roof is sound with a view of reducing leakage through the strata to a minimum. Provision should be made for sampling of the fire gases, water gage readings, and for reducing pressure if necessary by "bleeding off" the fire gases. No seal can be made hermetically airtight, but every effort should be put forth to construct them as tightly as possible. If

[1] Published with approval of the Director, U. S. Bureau of Mines. Presented before American Mining Congress, Cincinnati, Ohio, May 16-20, 1927.

[2] Supervising engineer, Instruction Section, Safety Division, U. S. Bureau of Mines.

[3] Ryan, J. T., Fighting and Sealing Mine Fires in Gassy Coal Mines. Paper presented at Annual Coal Convention of American Mining Congress, Cincinnati, Ohio, May 27, 1926. 30 pp.; reprinted in Mining Congress Journal for July, 1926.

there are excessive leaks around and through the seals, or if there are cracks or breaks to the surface or overlying measures, effort to control oxygen and extinguish the fire will be futile. There should be a constant decrease of the oxygen content in the samples collected from behind fire seals and if this does not occur it usually can be attributed to leaky stoppings or breaks in the strata or coal which permit air leakage. Sometimes, the oxygen will be reduced rapidly and consistently and then, with slight fluctuations, remain almost stationary. This condition can also usually be traced to the same cause. In both cases a thorough examination should be made of conditions and an extra effort put forth to close any leaks. Stoppings should be frequently inspected and any cracks in or around the stopping promptly repaired.

"Breathing" of Sealed Areas

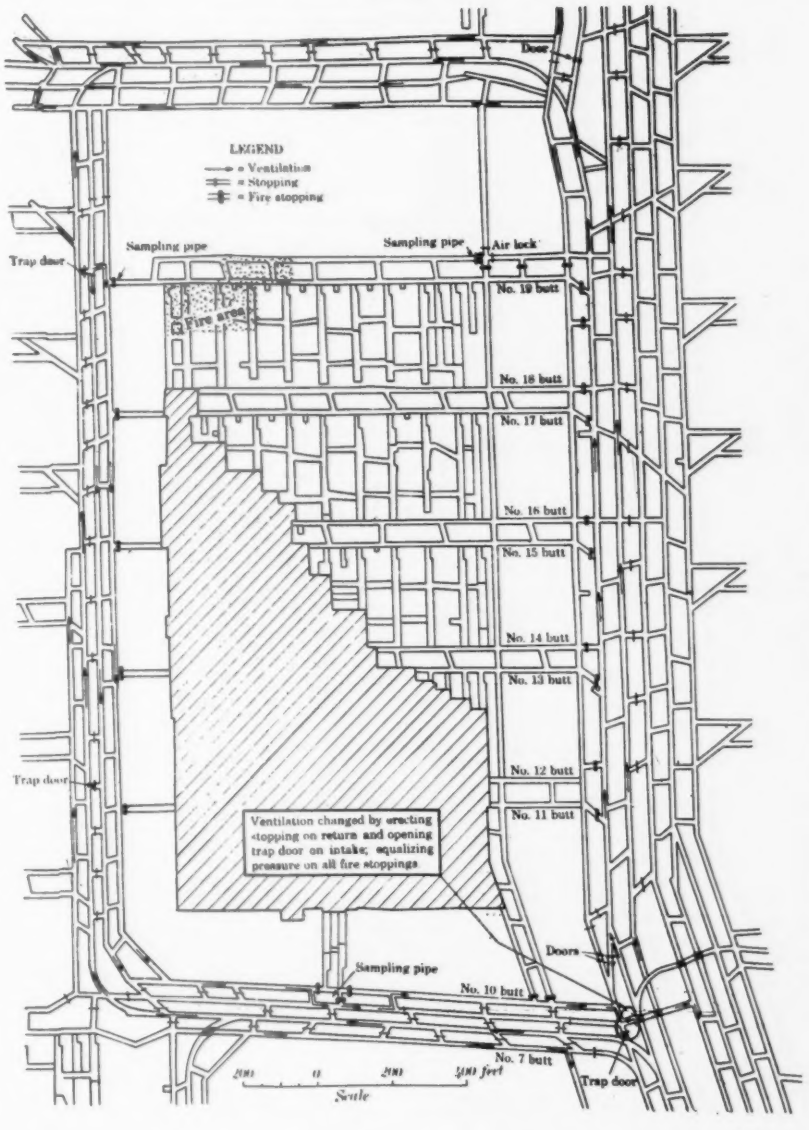
Barometric pressure has an influence on sealed areas as it is largely responsible for the so-called "breathing" in and out. An increase of barometric pressure in excess of the pressure behind seals will result in air entering the sealed area. Similarly, a decrease in barometric pressure that is less than the pressure of the sealed area will result in outward leakage through or around the stoppings. The latter condition assists materially in reducing the oxygen and aids dissipation of carbon monoxide. Frequently, sufficient pressure is developed in the enclosed area to offset any increase in barometric pressure, and when these ideal conditions prevail there will be a continual outward pressure against the seals.

Facilities for taking water-gauge observations should be provided in one or more of the stoppings that enclose the fire area. When the water-gauge indicates that pressure is increasing in the fire area, the excess pressure may be "bled off" under a water seal, if it is found advisable to do so.

Importance of Proper Sampling and Accurate Analyses of Fire Gases

It is of the utmost importance that proper sampling and accurate analyses be made of the fire gases so that the analyses indicate without a question the composition of the gases in the sealed area. Samples should be collected from behind stoppings only when the pressure is outward, as samples collected when there is inward pressure are usually inaccurate and, consequently, not representative of the sealed atmosphere. Samples from fire areas should be collected at least once every 24 hours during the first few days. Later, when the analysis shows that the stoppings are tight by the reduction of oxygen, the collection of samples can be made at longer intervals, possibly once a week or even longer.

There are three methods that can be employed in the collection of samples—namely, by vacuum tube, water displacement and air displacement (using an aspirator bulb or pump). Of the three methods, the vacuum tube is preferable, as it is more easily sealed, can be stored indefinitely, and is best adapted for shipping. After samples have been collected they should be accurately analyzed. Portable field apparatus can be used where extreme accuracy is not essential. The modified Orsat apparatus is accurate to approximately 0.20 percent. If greater accuracy is desired, the samples should be sent to a laboratory equipped for accurate work, where analysis as accurate as 0.01 or 0.02 percent can be made.



MA-1

Fig. 1—Sealed Fire Area, Oakmont Mine, Hillman Coal and Coke Co., Barking, Pa.

What Carbon Monoxide in Sealed Atmosphere Indicates

The proper interpretation of the composition of fire gases is of vital importance in determining when it is reasonably safe to break the seals. It has long been recognized that the presence of carbon monoxide is an indication of active or recently active fire, and the absence of carbon monoxide is not a safe criterion that the fire has been extinguished, but rather that flame and more or less active combustion has ceased. Especially is this true where there is a large area under seal in which case carbon monoxide might be lost through dilution. No fire is safe to unseal with a view of ventilating the affected region until the carbon monoxide has disappeared. Even after the carbon monoxide has disappeared it is advisable to give ample additional time for the heated material and strata to cool before opening and ventilating the sealed area; in fact, it may be necessary under certain conditions to delay unsealing for several months before the area cools sufficiently to be reopened with safety.

Importance of Low Oxygen Content in Sealed Atmosphere

Before an attempt is made to unseal a fire, the oxygen in the sealed area must be sufficiently low to prevent the possible ignition of explosive gases, but before this condition obtains, active combustion will naturally have ceased. In their experiments on methane-air mixtures, Jones and Perrott[4] found that when the oxygen is reduced to 12.1 percent, flame propagation and explosion are impossible, no matter what propor-

[4] Jones, G. W., and Perrott, G. St. J., Oxygen Required for the Propagation of Hydrogen, Carbon Monoxide, and Methane Flames. Paper read before Spring Meeting of American Chemical Society, Richmond, Va., April 13, 1927.

tions of methane are present. The gases found in sealed areas contain, in addition to varying percentages of methane, small quantities of hydrogen, carbon monoxide and other combustible gases. The extent to which oxygen should be reduced under these conditions depends upon the relative quantities of hydrogen, carbon monoxide and other combustible gases present. The data available on this subject indicate that when the oxygen in a sealed fire area is reduced to 4 percent, there is little, if any, likelihood of an explosion occurring. However, it is desirable that the oxygen be reduced to at least 3 percent and preferably below 1 percent before an attempt is made to unseal, as these lower percentages give large factors of safety from dilution of the gas due to changes in barometric pressure or leaky seals during the process of unsealing, especially if the latter is done by the air-lock method.

Influence of Carbon Dioxide Fires

The influence of carbon dioxide contained in fire gases is clearly shown by Coward and Hartwell[5], who have determined that 25 percent or more of carbon dioxide is required to render methane-air mixtures incapable of flame propagation. They also found that there was a marked decrease in the upper explosive limits (15 percent) of methane-air mixtures and a comparatively slow increase in the lower limit (5 percent) by the addition of varying percentages of carbon dioxide. The practical application of these experiments shows rather conclusively that the explosion limits of methane-air mixture are unaffected by carbon dioxide, and that it plays little, if any, influence in the extinguishment of a fire under seal, because the percentage of carbon dioxide found in fire gases rarely exceeds 6 percent at the time for unsealing.

Effect of Ventilation on Sealed Area

The location of the fire area with respect to the system of ventilation may have considerable effect on the extinguishment of a fire. For example: An area sealed where the air current passes on two sides, one side being intake and the other return, as against an area sealed on one side only, such as a pair of entries, will cause a difference in potential that may induce leakage through the stoppings and strata. A condition of this sort may prolong the extinguishment of the fire. The fire at the Oak-

[5] Coward, H. F., and Hartwell, F. J., The Limits of Inflamability of Firedamp in Atmospheres which Contain Blackdamp. Safety in Mines Research Board Paper No. 19, 1926, London, England.

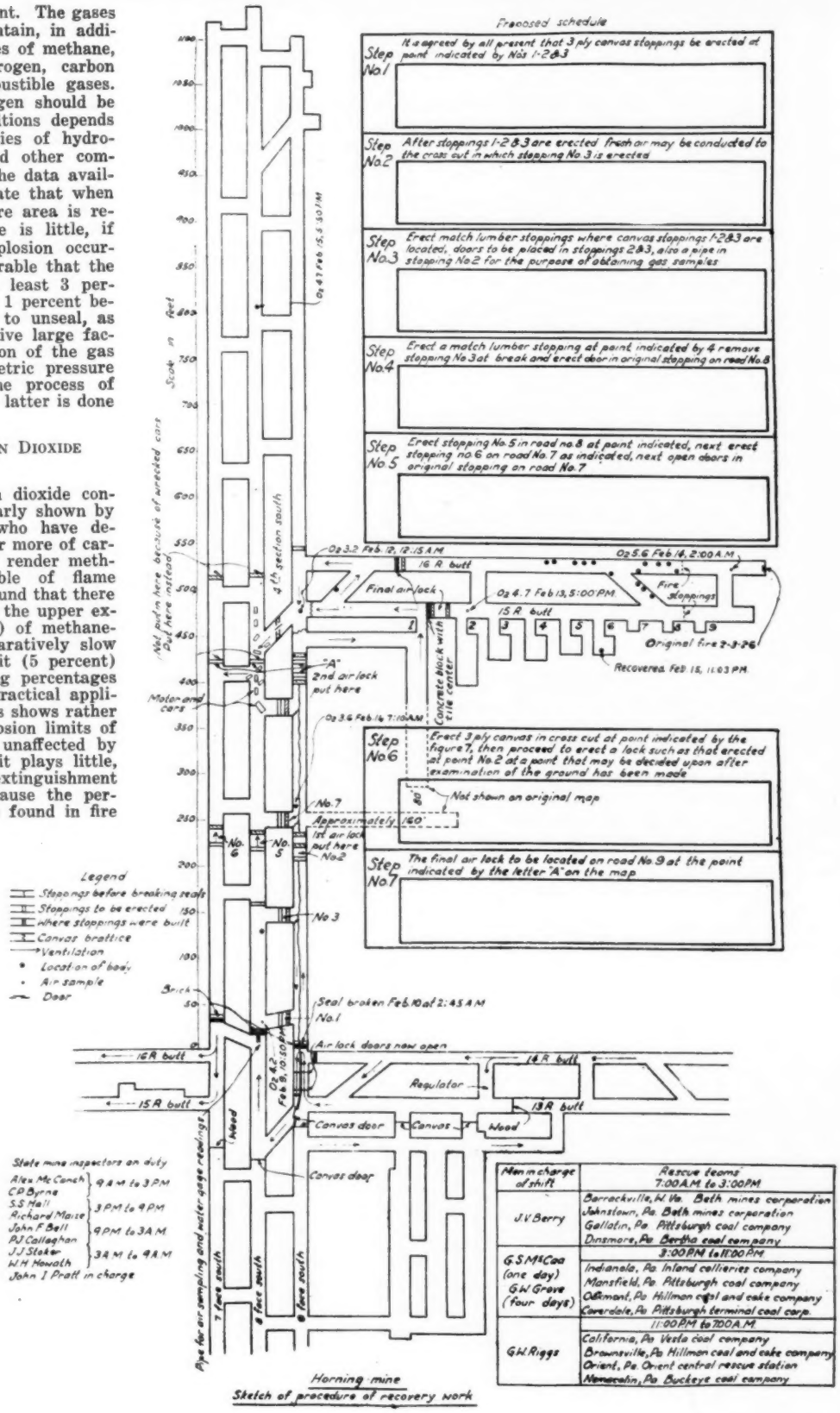


Figure 2

TABLE 1. ANALYSES OF AIR SAMPLES TAKEN AT THE HORNING MINE FIRE AND EXPLOSION (Fire and Explosion Occurred February 3, 1926)

Sample No.	Date 1926	Hour	Location	Percent by volume CO_2	O_2	CO	CH_4	N_2	Water Gage in Stopping, inches	Barometer in Mine, inches
1	Feb. 5	12.00 noon	8 face stopping	2.4	13.4	0.8	11.3	72.1	....	.....
2	Feb. 5	4.45 p. m.	8 face stopping	2.8	12.3	1.3	11.7	72.9	....	.....
3	Feb. 5	11.30 p. m.	8 face stopping	3.0	11.3	1.3	13.1	71.3	....	.....
4	Feb. 6	5.30 a. m.	8 face stopping	4.1	9.8	1.4	15.8	68.9	....	.....
5	Feb. 6	12.00 noon	8 face stopping	4.5	8.9	1.4	18.2	67.0	0.7	.....
6	Feb. 6	6.45 p. m.	8 face stopping	4.7	8.3	1.6	19.4	66.0	0.65	.....
7	Feb. 6	11.45 p. m.	8 face stopping	4.6	8.0	1.4	20.5	65.5	0.7	.....
8	Feb. 7	8.45 a. m.	8 face stopping	5.2	7.0	1.6	23.1	63.1	0.7	.....
9	Feb. 7	4.45 p. m.	8 face stopping	4.7	6.4	1.4	24.9	62.4	1.2	.....
10	Feb. 7	11.05 p. m.	8 face stopping	4.5	6.2	1.5	26.6	61.2	2.3	.....
11	Feb. 8	3.00 a. m.	8 face stopping	4.6	6.1	1.5	27.8	60.0	1.45	29.25
12	Feb. 8	11.05 a. m.	8 face stopping	4.6	5.5	1.5	29.9	58.5	1.8	29.17
13	Feb. 8	5.50 p. m.	8 face stopping	4.6	5.2	1.4	30.7	58.1	1.6	.....
14	Feb. 9	1.00 a. m.	8 face stopping	4.5	5.0	1.3	33.0	56.2	2.25	29.12
15	Feb. 9	11.00 a. m.	8 face stopping	4.6	4.7	1.3	34.5	54.9	1.2	28.89
16	Feb. 9	6.10 p. m.	8 face stopping	4.3	4.4	1.1	36.5	53.7	0.9	28.72
17a	Feb. 9	10.50 p. m.	8 face stopping	4.6	4.2	1.5	36.5	53.2	1.05	.....
18	Feb. 10	3.45 a. m.	8 face stopping	4.0	5.7	1.3	33.6	55.4	....	.....
19	Feb. 10	6.00 a. m.	160 feet inby seal on 9th face.	3.6	4.2	1.6	34.2	56.3	....	.....
20	Feb. 10	8.40 a. m.	Where stopping No. 3 is built.	3.7	3.9	1.3	38.7	52.4	....	.....
21	Feb. 10	10.20 p. m.	No. 3 Stopping after stopping was built.	3.8	5.5	1.3	36.3	53.1	....	.....
22	Feb. 10	10.20 p. m.	No. 2 stopping after stopping was built.	3.8	5.6	1.2	36.3	53.1	....	.....
23	Feb. 10	11.00 p. m.	From valve in 8th face stopping.	4.0	3.9	1.6	41.1	49.3	....	.....
24	Feb. 11	7.10 a. m.	9th face 27 feet inby break-through No. 7.	4.2	3.6	1.4	43.8	47.0	0.2	.....
25	Feb. 11	11.00 a. m.	From valve in 8th face stopping.	3.9	3.4	1.3	44.8	46.6	0.3	29.32
26	Feb. 11	11.45 a. m.	9th face 15 feet inby crosscut where No. 7 stopping is to be built.	4.0	3.5	1.2	43.8	47.5	....	.....
27	Feb. 11	11.45 a. m.	8th face 15 feet inby crosscut where No. 7 stopping is to be built.	4.0	3.5	1.3	43.3	47.9	....	.....
28	Feb. 12	12.15 a. m.	9th face 15 butt first advance.	4.0	3.2	1.4	46.6	44.8	....	.....
29	Feb. 13	4.45 a. m.	15 butt between No. 1 and 2 rooms.	3.5	4.5	1.2	44.6	46.2	....	.....
30	Feb. 13	9.50 a. m.	Outside stopping in 16 butt.	3.5	4.8	1.1	46.4	44.2	....	.....
31	Feb. 13	1.00 p. m.	15 butt between No. 1 and 2 rooms.	3.6	4.8	1.1	45.5	45.0	....	.....
32	Feb. 13	5.00 p. m.	Intersection of No. 2 room 15 butt.	3.5	4.7	1.0	45.5	45.3	....	.....
33	Feb. 13	10.30 p. m.	Inside chute 16 butt 100 feet from face.	3.1	4.6	0.7	46.5	45.1	....	.....
34	Feb. 14	2.00 a. m.	6 feet inby last crosscut on 16 butt.	3.1	5.6	0.9	45.6	44.8	....	.....
35	Feb. 14	10.00 p. m.	15 butt upper chute.	2.8	6.0	0.4	46.2	44.6	....	.....
36b	Feb. 15	5.50 p. m.	8th face 250 feet inby 16 butt.	2.5	4.7	0.5	52.8	39.5	....	.....
37c	Mar. 11	1.30 p. m.	Through seal 16 butt.	2.9	0.1	0.1	88.8	8.1	....	.....
38d	Mar. 13e	7.40 p. m.	Through seal 16 butt.	2.8	0.2	0.1	88.8	8.1	....	.....

(a) Seals were broken about 4 hours after taking sample 17. (b) Last body recovered on February 15; at 11.03 p. m. (c) Sample 37 taken 25 days after recovery of bodies. (d) Sample 38 taken 27 days after recovery of bodies. (e) Seals broken and area ventilated night of March 13, 1926.

TABLE 2. ANALYSES OF AIR SAMPLES TAKEN IN OAKMONT MINE SEALED AREA*. (Fire Discovered January 14, 1925.)

No.	Date 1925	Location Butt No.	Percent by volume CO_2	O_2	H_2	CO	CH_4	N_2	Remarks
1	Jan. 15	19 return	2.22	15.45	0.0	0.66	1.44	70.23	First sample after stoppings were completed.
2	Jan. 24	19 return	4.5	4.2	1.4	1.2	3.8	84.9	Hydrogen probably due to burning material falling in water.
3	Feb. 9	19 return	4.8	5.5	0.6	1.4	5.4	82.3	
4	Feb. 26	19 return	5.4	4.9	0.0	1.6	7.1	81.0	
5	Mar. 6	19 return	5.2	5.7	0.0	1.1	7.3	80.7	Explored back of stopping April 4, 1925.
6	Apr. 8	19 return	5.8	5.5	0.0	1.3	7.9	79.5	Started to flood behind seals.
7	Apr. 16	10 return	3.7	5.8	0.0	0.4	8.6	81.5	Unable to get sample at 19 butt closed by water.
8	Apr. 16	20 intake	5.0	6.1	0.0	0.8	8.3	79.8	Large volume of air pumped out before taking sample.
9	May 5	10 return	3.8	6.1	0.0	0.3	9.2	80.6	
10	May 5	20 intake	3.5	7.5	0.0	0.4	10.5	78.1	Large volume of air pumped out before taking sample.
11	June 11	10 return	2.4	5.6	0.1	0.1	10.7	81.2	Hydrogen probably due to water reaching fire in roof.
12	June 11	20 intake	3.9	8.5	0.6	0.0	18.5	68.5	Hydrogen probably due to water reaching fire in roof.
13	June 22	10 return	2.7	7.7	0.0	0.03	11.1	78.47	
14	June 22	20 intake	3.8	6.1	0.0	0.0	19.8	70.3	Considerable pumping to get sample.
15	July 10	10 return	3.1	6.9	0.0	Trace	10.7	79.3	
16	July 10	20 intake	3.1	4.7	0.0	Trace	18.6	73.6	Stopping under pressure.
17	Aug. 22	10 return	4.3	2.1	0.0	0.0	17.1	76.5	
18	Oct. 8	10 return	4.6	0.8	0.0	0.0	20.8	73.8	
19	Oct. 8	20 intake	3.3	0.4	0.0	0.0	26.4	69.9	Stopping under pressure.

* Seals broken and area ventilated night of October 15, 1925.

mont mine, Pennsylvania, which will be referred to later, is a striking example of how a fire could not be extinguished for approximately six months because of air circulation through the sealed area, which was caused by different parts of the sealed panel being under different amounts of suction or negative pressure. (See Figure 1.)

Composition of Fire Gases from Successfully Unsealed Mine Fires

Tables 1 and 2 give analyses of fire gases taken from the Horning and Oakmont mines, near Pittsburgh, Pa.

Discussion of Horning Fire Gases

It will be noted that the first sample taken at noon, February 5, showed 13.4 percent oxygen. Subsequent samples taken at frequent intervals showed a constant and somewhat rapid reduction in the oxygen content from the first sample to No. 17 (4.2 percent) collected 10.50 p. m., February 9. This reduction from 13.4 percent to 4.2 percent was probably hastened by a gas feeder which was the source of the original fire and the subsequent explosions. The gas issuing from the feeder caused an increased pressure in the enclosed area, which in turn reduced the oxygen content in the air by outward leakage of the atmosphere under seal through the stopping that enclosed the fire. This fact is clearly brought out by a study of Table 1 which shows 11.3 percent methane on February 5 and 33.6 percent on the 9th. The recovery of the affected region was started by a system of air-locks on the 10th and completed on the 15th. It will be observed that the maximum oxygen increase during this period, while rescue crews were at work, was only 1.4 percent, and the methane increased from 34.2 to 51.3 percent. Seals were placed in the entry where the fire originated on February 15, and no attempt was made to ventilate the affected area until March 13. At this time the oxygen and carbon monoxide content were 0.2 percent and 0.1 percent, respectively. An exploration trip by rescue crews on March 13 proved that the fire had been extinguished. A full account of this occurrence is given under "Procedure Used in Unsealing Horning Mine Fire."

Discussion of Oakmont Fire Gases

On January 14, 1925, a section (see Figure 1) of the Oakmont mine was sealed, following the discovery and sealing of a fire. It will be observed from Table 2 that the first sample collected on January 15 contained 15.45 percent oxygen and another sample collected on the 24th contained 4.2 percent. This was the lowest oxygen content shown over a long period, as a subsequent sample collected on March 6 contained 5.2 percent. When the oxygen content showed no reduction, the stoppings surrounding the fire area were reinforced and every effort was made to stop leakage of air. On April 4, in order to definitely ascertain conditions within the sealed area, an exploration was made by rescue crews behind the seals adjacent to the fire. This exploration was made through an air-lock, thus admitting a minimum amount of oxygen. When unmistakable indications of fire were found by the rescue crews, the area was resealed and flooding of the enclosed area attempted. The flooding was afterwards found to have been unsuccessful owing to the difference in elevation within the sealed area. Reference to Table 2 shows that after resealing the subsequent samples contained a slight increase in oxygen and that virtually no reduction was effected until after July 11, 1925. About this time the ventilation was changed by building a stopping in the return from No. 10 butt and by opening the trap-door on the intake airway outby No. 10 butt. The change in ventilation placed an equal pressure on all stoppings that enclosed the panel. A sample taken on August 22 showed 2.1 percent oxygen, and samples taken on October 8 showed 0.8 percent at No. 20 butt and 0.4 percent at No. 10 butt, respectively. On October 15 the area was explored, and as no indications of fire were found it was reventilated.

Conclusions Regarding When to Unseal Fires

It is obvious that very careful consideration must be given to all of the foregoing factors in the proper determination of the time for unsealing, as an error in any one of them may necessitate resealing and may be accompanied by disaster. Haphazard methods of procedure frequently employed by inexperienced and incompetent persons have also proved costly to life and property. It is therefore essential that an efficient organization and correct procedure be emphasized in order to unseal fire areas with the maximum degree of safety.

How to Unseal Mine Fires

Organization

An efficient organization is absolutely essential for the safe handling of the work of unsealing a mine fire. The organization should be headed by a cool, competent person, well versed in the technique of mine fires. In addition, there should be an advisory committee of mining men thoroughly experienced in mine fires, and more or less conversant with local conditions. They should also be well versed in recovery procedure, protective and detective apparatus, and devices necessary for the safety of those engaged in the undertaking. A plan for the safe conduct of the work should be formulated by the man in charge and his advisors before actual work is commenced, and there should be no deviation from the plan as outlined unless approved, after careful consideration, by those in charge of the situation. If the unsealing operations are extensive, such as where there is a large area under seal, requiring days and even weeks before the seat of the fire can be reached, the work should be arranged in 6 or 8-hour shifts. An experienced man should be placed in charge of each shift, as an assistant to the man in charge of the entire operation. Well-trained crews, physically able and experienced in the use of oxygen breathing apparatus should be a part of any organization engaged in unsealing mine fires. They should be provided with all necessary equipment to conduct the work successfully. At least two complete crews should be underground at all times and no crew should make an exploration or work in advance of fresh air, without a reserve crew at the base of operations. The remainder of the underground organization should consist of foreman, certified firebosses, carpenters, masons, drivers, laborers and others necessary to carry out the work safely and efficiently.

The surface organization should consist of a man stationed at the fan continuously, a man or men to search for smoking materials such as matches and patent lighters and to check the underground workers in and out of the mine, chemists for making air analysis, and other men as may be required. When it is known that the operations are going to be of considerable duration, at least two competent men should be provided on each shift to clean, recharge, test and repair the oxygen breathing apparatus being worn by the underground crews. Provision should be made on the surface for a mess room and sleeping quarters for those engaged in the work. No persons other than those directly engaged in the work of unsealing a mine fire should be permitted underground.

Ventilation and Rock-Dusting

The successful opening of any fire area will necessitate a certain amount of preparatory work. Necessary adjustments in ventilation should be made so that the return from the fire area can be directed into the main return. Return airways should be inspected and if necessary, arrangements made to confine the fire gases to the main return so as to prevent the gases from circulating or accumulating in other portions of the mine. All entries leading to and from the fire area should be heavily coated with rock-dust at and outby the seals that are to be broken. As an additional precaution, rock-dust barriers should be erected close to the seals and at other advantageous points; especially should this be done in return airways which will be used for conducting the firegases to the surface.

Material Required

Material necessary for building stoppings, air-locks, line brattices, etc., together with necessary tools, should be placed at convenient points close to the seals that are to be broken. If air-locks are to be used in the unsealing operation, doors for these can be previously constructed and placed where they will be readily accessible. Every expedient should be utilized in procuring and advantageously arranging materials to avoid unnecessary delay when the actual work of unsealing is undertaken.

Electric Power Cut-Out

It is essential that the electric current be cut out from that section of the mine in which the fire is sealed, even before the actual work of unsealing is undertaken. Moreover, when the seals are broken it is absolutely necessary that the electric current be cut off from the whole mine in order to eliminate the possible ignition of gas through arcs or sparks. Men engaged in the preparatory work or the actual unsealing of a mine fire must be provided with closed lights, preferably approved electric cap lamps or flashlights for illumination.

Devices for Detecting Gases

Safety and good mining practice requires that ample means for the detection of mine gases be provided for persons designated to use them. The necessary devices for the detection of mine gases are: Permissible flame safety lamp, Burrell indicator, possibly a continuous methane recorder (main return only), also canary birds, "Hoolamite" detectors (carbon-monoxide detectors), pyrotannic-acid outfits for detecting carbon monoxide, and a portable Orsat gas analysis outfit.

Flame Safety Lamps

A minimum number of flame safety lamps which will suffice for detecting methane or oxygen deficiency should be taken underground; perhaps two or three will serve the requirements at any one time. They should be carefully cleaned, filled, assembled, inspected, and tested. It is desirable that the lamps be tested in a lamp-testing cabinet filled with gasoline vapors before they are taken underground. Only competent persons familiar with their use should be designated to carry flame safety lamps, and as an additional precaution to insure the safe condition of lamps, these persons should also carefully examine the lamps before taking them underground.

Canary Birds and Other Detectors

It undoubtedly will be advantageous to have canary birds available at the fresh air base to detect carbon monoxide. Their use is limited to the fresh air base because they can not be used in the sealed area on account of oxygen deficiency. As the Hoolamite detector is adapted for use whether oxygen is present or not, it can be used by crews exploring behind the fire seals, also by crews examining the return from the fire area. The pyrotannic-acid method is invaluable for indicating small amounts of carbon monoxide, though its use requires more technique than the canary bird or Hoolamite detector; it is the most accurate method known when the carbon monoxide does not exceed 0.2 percent. It can also be used for determining the amount of carbon monoxide in blood.

Orsat Apparatus

A modified, portable Orsat gas-analysis apparatus is indispensable for use preparatory to and during the actual work of unsealing a mine fire. The work of analyzing fire gases should preferably be in charge of an experienced chemist who can properly interpret and explain to those in charge the significance of changes in gas composition within the sealed area. The apparatus should be installed on the surface and just prior to unsealing, a check sample of surface air and of fire fumes should be taken and a complete analysis made for oxygen, carbon monoxide, methane, and carbon dioxide. Quick determinations may be made for oxygen by a portable apparatus installed at or near the fresh air base. This is necessary to prevent delay in transporting samples to the surface for analysis. However,

no determinations for combustible gases should be made underground. As recovery work progresses, frequent determinations should be made underground for oxygen. This should be supplemented with complete analysis of samples taken at stated intervals and analyzed on the surface. Those in charge of the work should be guided by the advice of the chemist with respect to the proper interpretation of the gases. A complete log should be kept of the analyses for reference and guidance, and a curve drawn therefrom and extended as analyses are completed. This curve or curves would be so formulated as to indicate the percentage of gases against time.

Oxygen Breathing Apparatus

It is of prime importance for the safety and protection of the men engaged in the work that an ample supply of permissible oxygen breathing apparatus and of approved types of gas masks in first-class condition be available. Breathing apparatus will be required by rescue crews working in advance of fresh air. The use of approved types of gas masks must of necessity be limited to places where a flame safety lamp will burn and can safely be used. Where the recovery work is likely to be extensive it is advisable, in order to expedite the work, to establish an underground base for charging, testing, and repairing breathing apparatus and gas masks.

Other Instruments Needed

In addition to the apparatus used for detection of mine gases and protection against them, other miscellaneous apparatus and equipment will be required, such as anemometers, barometers, maximum and minimum thermometers for taking temperature observations, oxygen inhalers, first-aid supplies, a lifeline for use of rescue crews, and fire extinguishers.

Other Materials Required

Materials necessary for unsealing will depend, to a considerable extent, upon local conditions. An adequate supply of brattice-cloth, boards, posts, and other necessary lumber for building air-locks, stoppings, and line-brattices, should be at hand. For possible emergency that may arise it is advisable to have on hand a supply of building material such as brick, tile, cement, sand, trowels, bricklayer's hammers, mortar boxes and water. Hammers, axes, saws, sledges, hatchets, picks, bars, and nails should also be available. To minimize the likelihood of ignition of gas through sparks, while work is being done in air-locks, within the enclosed fire area or in proximity to the seals, it is decidedly desirable, if not imperative, that copper hammers, nails, and bars and wooden wedges be used.

Methods of Unsealing

The method to be used for the recovery of a fire area must be planned and outlined in detail before the seals are broken. There are in general two systems that may be employed, namely, (1) recovering an area in successive blocks by means of air-locks, and (2) re-ventilation of an area after there is conclusive evidence that the fire has been extinguished. When the sealed area is extensive, the fire inaccessible, or the exigencies of the case necessitate the removal of bodies from a previous explosion, the area should be recovered in sections by using air-locks and advancing to a point where observations can be made, or the bodies recovered. After the air-locks have been advanced sufficiently close to the seat of the fire so that observations can be made, it may be possible to load out heated material through the air-locks, as was done at the fire in the Sunnyside mine, Sunnyside, Utah.[6] When the area under seal is relatively small, so that it can be explored by rescue crews under reasonably safe conditions, and there is every indication that the fire has been extinguished, the area should be re-ventilated and the fire gases removed as quickly as possible, preferably with all persons out of the mine.

Recovering a Sealed Area by Use of Air-Locks

Prior to breaking the seal on the intake side of the area a tightly constructed air-lock, preferably of matched lumber should be erected at a convenient distance from the seal. When barometric conditions are favorable, all other things being in readiness, a crew of at least five men wearing oxygen breathing apparatus and fully equipped for the work at hand, with a reserve rescue crew of at least five men at the air-lock, enters and breaks the seal. The advance crew, using a life-line, makes an exploration to the point where the next air-lock is to be erected, at a distance generally not to exceed 500 feet. General conditions are observed; temperature readings are taken; measurements are made for material required to construct the air-lock; and an air sample is taken to check previous analyses; after this the crew returns to the fresh air base. Crews wearing breathing apparatus, with a reserve crew at the fresh air base, next construct an air-lock at the place previously selected; erect necessary stoppings in parallel entries to ensure resealing of the inby area; examine the unexplored parts of the isolated section for possible fire; and make the necessary changes so that the fire gases from this localized area may be directed to the return airway. Following this, the seal on the return side is broken by a rescue crew; this area is then re-ventilated by regulating the quantity of air so that the return from the mine will be kept below the lowest explosive limit.

In like manner, advances are made by successive blocks until the entire area is recovered. As the work progresses, frequent analyses must be made to determine the composition of fire gases inside of the air-locks. The oxygen must be under control and within safe limits at all times.

Recovering a Sealed Area by Direct Ventilation

When a decision has been made to recover a sealed area by direct ventilation, an air-lock should preferably be constructed near the intake seal. A rescue crew using a life-line and fully equipped for the work at hand, breaks the seal, enters, observes conditions, takes temperature readings and air samples, and returns to the fresh air base. If the observations and examination of the affected region have shown that conditions are favorable, the return seal is broken by an apparatus crew, after which the air-lock is opened to admit air. The area is ventilated, but the combustible gases in the main return should, if feasible, be kept below the lowest explosive limit.

If this method of recovering a fire area is employed, it is advisable that all men be out of the mine before the air is actually directed into the sealed area. Some automatic arrangement should be employed which would give sufficient time for all persons to reach the surface before the fire gases were actually moved. A reasonable period should be given for the fire gases to be removed and frequent determinations should be made of the return from the mine, and the time for any person to enter should be governed by the quality of the return air. This may be accomplished by installing a continuous methane recorder in the main return from the mine or by systematic periodical sampling and analyzing. If the workings under seal are of an extensive nature, it will probably be advisable for crews equipped with oxygen breathing apparatus or possibly gas masks to re-enter the mine and completely clear out the fire area of any standing fire gases.

Procedure Used for Unsealing the Horning Mine

A section (see Figure 2) of the Horning mine was sealed following an explosion which occurred during the sealing of a fire, February 3, 1926, and resulted in the death of 20 men. Three bodies had been recovered by rescue crews when a second explosion occurred making it dangerous to attempt to recover the other 17 victims. After careful deliberations by those in charge of the situation, it was decided to seal the affected region, and the recovery of the bodies would be done by a system of air-locks when the oxygen content of the sealed area had been reduced to 4 percent.

The sealed area is known as the fourth section south and consisted of three face entries, Nos. 7, 8, and 9 south, and two butt entries, leading from the face entries, known as No. 15 and 15 butt right entries. The face entries extended a distance of approximately 1,100 feet from the seals to their faces, and at a point about 500 feet from the seals the two butt entries were turned off from the face entries. The butt entries extended a distance of about 500 feet from the face entries to their faces. Nine rooms, ranging from about 12 to 120 feet in depth, were turned off No. 15 butt right; no rooms were turned off No. 16 butt. The total distance from the seals to the face of the butt entries was about 1,000 feet. The fire which caused the explosions was at the face of No. 16 butt right, and it was thought that nearly all of the entombed men would be found on No. 15 and 16 butt entries; which proved to be correct.

Construction of Seals

The permanent seals were in No. 7, 8, and 9 face entries and were completed at about 8 a. m., February 5; the stoppings were constructed of brick and tile. A pipe was placed in the stopping on No. 8 face entry to collect air samples and take water-gage readings. The pipe was equipped with valves and one end of the pipe was buried in a tub of water to release pressure if necessary.

Analysis of Atmosphere Behind Seals 3½ Hours After Sealing

The first air sample was taken from behind the seals at about 11.30 a. m., February 5, and gave the following analysis: 2.4 percent CO_2, 13.4 percent O_2, 0.8 percent CO, 11.3 percent CH_4, and

[6] Allen, C. A., and Watts, A. C., Apparatus Men Load Out Heated Material from a Mine Fire in a Cooling Current of Oxygen-Depleted Air. Coal Age, Vol. 21, March 23, 1922, pp. 479-483.

72.1 percent N_2. Following this, air samples were taken at about 8-hour intervals. The samples taken were analyzed by a modified Orsat apparatus on a Bureau of Mines rescue car by chemists from the Pittsburgh Experiment Station.

Water-gage and barometer readings were taken frequently and a close check kept on the pressure behind the stoppings. When the pressure behind the seals reached 2.25 inches water gage, the valve in the stopping on No. 8 face entry was opened and the pressure bled off through the pipe placed in the tub. This prevented the pressure from increasing. At no time during the recovery operations did the water gage show that the sealed area was under suction. However, on one or two occasions the outward pressure was very slight due to a falling barometer.

Construction of Stoppings and Air-Locks

The period necessary for the oxygen to be reduced was utilized to good advantage in building stoppings for ventilation purposes outby the sealed area, obtaining and placing materials close to the seals, and rock-dusting all the entries and crosscuts in proximity to the sealed area. During this time an air-lock with a line brattice was also built outby the stopping on No. 9 face entry.

The air-lock constructed on No 9 face entry, and those mentioned later, consisted of two stoppings approximately 15 to 20 feet apart. These were constructed of matched white pine, with all openings and cracks filled with stiff mud. Each stopping had a large door 2 by 5 feet on hinges and means of fastening; and a slide door 2 by 2 feet. A line-brattice built of matched lumber was built midway in the entry within the air-lock from one stopping to the other. The large doors of the air-lock were used for ingress and egress of rescue crews and for handling materials; the small doors, when opened, served as the return from the ninth face entry when ventilation was established to the next air-lock. By building air-locks of this kind a crew wearing oxygen breathing apparatus could pass through the first door, close this door and open the inside door, pass through, closing the second door also and carry on their work. On returning, the inside door was closed before the outer one was opened, thereby keeping one door closed at all times and preventing as far as possible, air from entering the sealed area from the outside.

All stoppings and air-locks were built with white pine 2 by 4-inch frames and uprights, matched lumber, and copper nails. Copper hammers were also used in all construction work. As already mentioned, all cracks and openings were filled with mud in order to cut down leakage as much as possible.

Analyses of Atmosphere Behind Seals 106 and 111 Hours After Sealing

At 6.10 p. m., February 9, or about 4 1/3 days after the permanent seals had been erected, the air analyzed as follows: 4 percent CO_2, 4.4 percent O_2, 1.1 percent CO, 36.5 percent CH_4, and 64.0 percent N_2. It was decided at this time that the seals would be broken when the 11 p. m. shift went underground. It was thought that by the time all necessary arrangements could be made the oxygen would have been about 4 percent. Analysis of a sample taken at 10.50 p. m. gave 4.6 percent CO_2, 4.2 percent O_2, 1.5 percent CO, 36.5 percent CH_4, and 63.2 percent N_2. By the time the stopping was removed in No. 9 face entry it was 2.45 a. m., and no doubt the oxygen was reduced to 4 percent or less.

Details of Reopening Fire Area

Three 8-hour shifts were employed. The personnel of each shift consisted of a man in charge, two or three assistants to the man in charge, two State Mine Inspectors, four rescue teams of five men each, wearing oxygen breathing apparatus, and laborers, drivers, and others.

The organization at the fresh-air base consisted of the man in charge, one or more of his assistants, two State Mine Inspectors and the rescue crews. Before entering the air-lock each apparatus crew was given detailed instructions as to the work they were to perform.

When one or more apparatus crew were working or exploring they were at all times backed up with a reserve crew stationed on the inside of the air-lock. Not more than five permissible flame safety lamps were permitted underground on each 8-hour shift, and permissible electric cap lamps and flashlights were used exclusively.

After breaking the seal in No. 9 face entry, a crew wearing apparatus supported by another crew, passed through the air-lock and advanced approximately 225 feet in No. 9 face entry. The construction of another air-lock was started at this point. When this air-lock was completed, two stoppings were erected in break-throughs between Nos. 8 and 9 face entries. An air sample taken at this time gave 5.2 percent oxygen between the two air-locks. At the completion of this work the first air-lock was opened and a line canvas extended from No. 1 to No. 2 air-lock, thereby conducting fresh air to the outer door of No. 2 air-lock. Following this, stoppings were erected on No. 7 and 8 face entries, by working through No. 2 air-lock. When these were completed, an exploration was made between the seals and the newly erected stoppings in No. 7 and 8 face entries. These two entries were then ventilated to the new stoppings. One body was recovered during this operation in No. 8 face entry.

Following this, a crew advanced about 250 feet more in No. 9 face entry, or just outby No. 15 butt. They obtained an air sample at this point and started the erection of No. 3 air-lock. The analysis gave 4.0 percent CO_2, 3.2 percent O_2, 1.4 percent CO, 46.6 percent CH_4, and 44.8 percent N_2.

On completion of the air-lock two stoppings were again erected between No. 8 and 9 face entries and a line brattice extended and air conducted from No. 2 to No. 3 air-lock. From this air-lock, stoppings were erected in No. 7 and 8 face entries, also in No. 16 butt entry and an air-lock in No. 15 butt between No. 1 and 2 rooms. One body was recovered in a break-through between No. 15 and 16 butts during this operation.

The only difficulty encountered in the erection of stoppings occurred on the two stoppings erected at this point in Nos. 7 and 8 face entries. A trip of cars and a motor were found in No. 8 face entry. The cars were wrecked and jammed in the entry at the place where the stoppings were to be erected. It was necessary to change the location of these two stoppings and cut one of the cars to permit the apparatus men to work around the wrecked cars in safety.

After ventilating the face entries and No. 16 butt to the newly erected stoppings and No. 15 butt to the air-lock, a crew was sent on an exploration trip into Nos. 15 and 16 butt entries and found the bodies of 14 men, this making the total of 16. All of the bodies excepting one which had not been found were recovered and passed through the air-lock by 5.00 a. m., February 14. Analysis of an air sample taken inby the last break-through in No. 16 butt gave 3.1 percent CO_2, 5.6 percent O_2, 0.9 percent CO., 45.6 percent CH_4, and 44.8 percent N_2.

The last body was recovered the following night (11.03 p. m.) from under a fall of slate at the face of No. 6 room off No. 15 butt. After the last body was recovered on February 15 permanent seals of concrete blocks with tile centers were erected outby the air-lock in No. 15 butt and the stopping in No. 16 butt. The area was left under seal until March 27th, at which time it was unsealed and reventilated. This operation was conducted in the following manner:

Unsealing and Re-Ventilating the Fire Area

A base of operations was established outby the seal in No. 15 butt, and all necessary materials and equipment required for the unsealing were placed at the fresh-air base. Three rescue crews were employed for this work, namely, No. 1 and 2 crews, respectively, with No. 3 crew in reserve broke the intake seal and entered the air-lock. No. 1 crew advanced to the face of No. 16 butt, tested for carbon monoxide, and placed a maximum and minimum thermometer at what was considered the hottest place. No. 2 crew placed a maximum and minimum thermometer in the first break-through inby the seal on No. 15 butt, and advanced to between rooms 8 and 9 in No. 15 butt. All crews then returned to the outside of the air-lock and reported. No. 1 crew reported that the maximum and minimum thermometers placed at the face of No. 16 butt and in the first break-through inside the air-lock read the same, and that there was no indication of carbon monoxide or heat.

To check these observations, a second exploration trip was made; No. 2 crew went to the face of No. 16 butt and No. 3 crew to between rooms 8 and 9 in No. 15 butt. No. 1 crew acted as reserve. Similar observations and reports were made. A sample taken at the seal, No. 16 butt, March 11, showed 2.9 percent CO_2, 0.1 percent O_2, 0.1 percent CO, 88.8 percent CH_4, and 9.1 percent N_2, and with this favorable analysis it was decided to re-ventilate the area. A line brattice was extended through the chute outby the seals in No. 15 and 16 butts and the seal in No. 16 butt was opened by a rescue crew. The doors in the air-locks in No. 15 butt were then opened and the fire gases removed as quickly as possible. The rescue crews entered the area and removed the standing fire gases in the rooms off No. 15 butt.

Outstanding Factors in the Successful Unsealing of the Horning Fire

Twelve crews of five men each wearing oxygen breathing apparatus built all air-locks and stoppings. In addition, they made exploration trips and carried all the bodies to the fresh-air base. Three crews were later used in unsealing the final block on March 13, 1926. No long

trips were attempted at any time; 300 to 400 feet was the maximum distance traveled. All of the crews engaged in the operation did exceptionally good work, and too much can not be said for their training, obedience, willingness, endurance, and courage. The entire operation was carried on without injury to anyone and with but little difficulty with apparatus. The work was carried out systematically and safely. A large measure of this can be attributed to a well-planned and well-organized system before the work was started followed by strict adherence to the plan as outlined. The air sampling and analysis, which showed the condition behind the stoppings at all times, were other important factors in the successful operation of the work. The type of men composing the apparatus crews also materially aided in the successful completion of the task. This was undoubtedly one of the best, if not the best, organized and equipped recovery operation ever conducted. All plans were drawn and the work outlined in detail before the seals were broken. The personnel engaged in the work was carefully chosen and ably directed. In fact, the whole operation is an outstanding example of what can be accomplished by proper organization and procedure.

ACKNOWLEDGMENTS

I have to thank George W. Grove, assistant mining engineer, Instruction Section, Safety Division of the Bureau of Mines, for assistance in preparation of this paper, also to Frank Dunbar, General Superintendent, Hillman Coal and Coke Company and G. F. Osler, Vice-President and General Manager, Pittsburgh Terminal Coal Corporation, for permission to use maps and data relating to Oakmont and Horning mine fires.

SAFETY IN MINES

(*Continued from page* 510)

kind of powder in the same drill hole; see that holes are properly drilled and not drill them on the solid; he should not overcharge the holes, and should use noncombustible material for tamping. He should set a center post in roadway directly in front of car, and when place is dipping safety stops should be used to prevent car from running toward face; safety posts should be set along the face to protect himself while loading coal. If electric detonators are used the shooting cable should be hung to staples along the roadway and not allowed to lay on bottom, as stray currents may set off blast premature. The miner should have the necessary tools in order that he can perform his work properly. Explosives should be kept in fiber cannisters and detonators in wood boxes, and in working places they should be kept separated at least 25 ft. in holes dug in the rib. No miner or other employe should be allowed to mine coal or operate any machinery unless he has had the necessary experience to qualify him in the work.

If each employe, either official or workman, carry out all rules, a reduction in the number of accidents will be the result, but before getting the miners and other workmen to carry out the rules pertaining to their work, the officials must carry out all rules pertaining to *their* work. The leader in doing this should be the foreman and in the case of coal mining the leader is not only the mine foreman but each official inside or outside of the mine. If any of the officials of the mine violate any of the rules of the company or state law, he should be disciplined the same as any other workman. This will have a moral effect on all. If officials violate rules or allow others to violate rules and let them go unnoticed by them, then all of the rules at the mine become worthless.

There should be different sets of complete rules adopted by each company, covering operation of mine, care of electrical equipment, and safety. These rules should cover each operation in detail, especially for the different classes of work, as a great many of the miners and other employes fail to comply with some of the minor details pertaining to their work which may cause accidents. Every operating company should establish a First Aid and Mine Rescue Department. Each employe should be required to take first aid training in accordance with Bureau of Mines standard, and each mine should have at least three mine rescue teams well trained according to Bureau of Mines standard of training. All officials at the mine should be qualified to instruct in first aid or mine rescue work, in order to get the best results. With all the rules obeyed, the mine will be in good condition. Safety clubs can then be established at each mine, and finally when all other conditions are corrected, *rock dust* the mine and you will have done practically all that can be done and you will reap the harvest of reduction in number of accidents, which is what we all hope to accomplish.

IMPROVING SAFETY THROUGH CONFERENCE ON IMPROVED FOREMANSHIP

(*Continued from page* 519)

munities. In fact, every phase and movement of an operating colliery was discussed in detail wherever there was a chance for an accident, and the remedy suggested for the prevention of that particular accident.

I wish to state, however, that the conference leaders drew from the class members the different kinds and places of accidents by analyzing the various jobs in and around a colliery. This method made possible the collection of a mass of information regarding the possibility of accidents and their prevention; the same then being correlated and tabulated in report form for the use of the conference members whenever they may take up their safety work at their respective collieries.

You will observe that this conference was very much in line with the improved foremanship conferences held by us approximately six years ago. The main difference being that it treats entirely on safety measures and accident prevention, and the work of the members of this conference will be to carry to their fellow workers the gospel of safety to themselves.

In order that any undertaking may be a success where a body of workers are required to produce a given product on a large scale, the most important situation to be met is to secure a spirit of cooperation amongst those employed. It matters not whether it be accident prevention or increased production. Our experience teaches us that the conference plan is the best method that thus far has been brought to our attention. If you can secure the full cooperation of the worker it is correspondingly easy to teach him mine safety and accident prevention. We unhesitatingly recommend the plan to you gentlemen for your earnest consideration.

SAFETY IN COAL PRODUCTION

(*Continued from page* 505)

The American Mining Congress expects soon to complete 'Safety Rules for Underground Transportation.' There is adequate testimony that the codes already issued have been of great value to state mining departments in making state rules and regulations, to the individual company, and to safety inspectors who want to take advantage of the best agreed upon practice, and to the various insurance companies and organizations engaged in writing coal mine workmen's compensation insurance.

"But a single code now and then is too slow progress. We need right now complete safety codes to cover all the risks incident to coal mining. It is proposed, therefore, that some organization be charged with the duty of preparing and recommending rules and best practices to cover the following:

COAL-MINE SAFETY CODES

1. Rock Dusting (completed).
2. Installation and Use of Electricity Underground (completed).
3. Underground Haulage and Transportation.
   a. Track and Roadbed.
   b. Haulage.
4. Timbering.
5. Methods of Testing and Taking Down Roof.
6. Work at the Face.
7. Mine Illumination.
8. Shafts and Hoisting.
   a. Ropes and Cages.
   b. Signals.
9. Slopes and Hoisting.
10. Ventilation.
11. Methods of Safety Inspection.
12. Care and Use of Explosives.
13. Mining Machines.
14. Mechanical Conveyors and Loaders.
15. Fires and Explosions.
   a. Organizations and Methods.
   b. Hazards.
16. First Aid and Mine Rescue.
17. Surface Hazards.
18. Danger Signs and Signals.
19. Mine Layout.
20. Escapeways and Manways.
21. Pillar Work.
22. Gas.
   a. In Mines.
   b. In Oil and Gas Wells.

"The coal-mining industry has been strangely slow to formulate its safety codes as compared with other industries. There have been completed and issued outside of mining 41 different safety codes covering a like number of industries, some of which are at least as intricate and variable as mining. For example, there are safety codes for marine work, for logging and sawmill and woodworking plants, for laundry machinery and operation, for building construction work, for the gas industry, for aeronautics, and for many other industries.

"All of these have been voluntary within the industry. There is unlimited testimony as to their value to manufacturers, employers, employes, governmental bodies with regulating or advisory power, safety inspectors and to the compensation insurance interests. Let us set our own safety house in order in the same way, by finding out what we can agree on as being the safest methods and then by making our findings available for the industry."

RELATIONSHIP BETWEEN SEALING AND UNSEALING MINE FIRES

A Detailed Description Of A Recent Mine Fire—What Happened, How It Was Handled—Rescue Work—Sealing The Fire—Exceptions To Rules Of Procedure Sometimes Made Necessary By Conditions Encountered

By J. T. RYAN*

THERE is one very important relation between sealing and unsealing a mine fire. That is, when you seal a mine for the purpose of excluding the oxygen to extinguish the fire you must at some future time unseal it and this procedure is fraught with many difficulties and hazards which must be taken into consideration when the sealing process is going on. Most of these points have been touched on rather fully in Mr. Forbes' paper and I will, therefore, not go into further details.

I apologize for not having prepared a formal paper, but I have been so busy in the last two months assisting in sealing and unsealing two mine fires that I have not had much time to write on the subject, so will consume the 10 minutes allotted to me in telling you a little about a recent occurrence that is fresh in the minds of most of you and which was one of the most hazardous procedures in mine fire work that many of us ever experienced. I am going to present it to you in the form of a hypothetical case and give you the facts up to a certain point, to get your opinion on what your procedure would have been under a like circumstance.

Referring to this map (Figure 1), which is on a small scale, being a photostat copy of a large 100-ft. map. This is a drift mine with a six-entry system, extending in approximately a mile and a quarter. Let us assume that there was an explosion in this mine, with the explosion wave coming out the mouth with sufficient force to kill six men on or in the vicinity of the tipple. It occurs in the late afternoon and, fortunately, there is not a full complement of men in the mine—approximately 100 altogether. The work of restoring ventilation is started as quickly as possible and the recovery work proceeds up to about the point indicated on the map as No. 2 South; in a comparatively short time considering that all stoppings and overcasts were completely demolished. Rapid progress has, as you will note, been made and the work is progressing very satisfactorily until the advance crew reaches the mouth of No. 2 South and discovers smoke. They immediately call other experienced men present to investigate it and, to make sure, a rescue crew is sent up to try and locate the fire. They proceed only a short distance when explosive gas flames in the safety lamp of the crew captain. They return immediately and report thick smoke and a gas condition which they estimate as between 3 and 4 percent. Another small group, including the mine inspector, don gas masks and enter to the edge of the smoke. The inspector tests for gas and finds approximately 4 percent of explosive gas.

Another group of three very experienced men are sent up to make a final check and obtain the same result with respect to explosive gas. The last crew, equipped with masks, made tests with a CO detector which indicated between 3 and 4 percent carbon monoxide present.

Understand, at this time only about 11 of the bodies have been recovered and there are still some 85 in the workings beyond this point. I ask you practical mining men in the audience what you would do under these conditions. All those present who would immediately cut the air off please raise their hands. (A few raise their hands.)

At this point a hurried conference was called by 11 or 12 experienced men who were directing the work up to this time and it was the unanimous opinion that the proper thing to do was to immediately shut the air off and let it rest for a few hours until breathing apparatus crews could be organized to go in and take some samples to determine the actual atmospheric conditions. At the time there were about 100 men in the mine engaged in the recovery work. The first step was to remove all these men immendiately, except about 20 who immediately proceeded to erect stoppings on the six slope entries. These six stoppings, with four additional stoppings at the mouths of 2nd and 3rd Northeast entries, indicated on the map, were necessary to cut the air off the entire mine beyond this point. You will note that we sealed the intake first. Before erecting the final return seals on No. 2 Northeast, Inspector Griffith, George McCaa of the Bureau of Mines, and myself, wearing gas masks, went in No. 2 Northeast to the point where it connected through to No. 3 Northeast, which would be the main return from the entire north side of the mine. A test taken here showed above 1 percent carbon monoxide, which led us to believe that it would be impossible for anyone to be alive in the mine beyond this point.

While constructing these temporary seals, and making them as air tight as possible, we kept in mind the relationship between sealing and unsealing, realizing that we would probably have to come back within a day or two and unseal the mine. So with this in mind, a small pipe with valve was placed in the stopping closest to the supposed fire area in order that samples could be taken. Our temporary stoppings were located, in each case, far enough inside the pillar points to permit the building of a 15-ft. air lock. Immediately upon completion, which was about 4.30 a. m., this crew of approximately 20 men were withdrawn from the mine without delay.

When we reached the drift mouth we found Mr. R. M. Lambie, Chief of the Department of Mines of West Virginia, who had just arrived on the scene after an all night drive from the southern end of the state. The first question he asked, without even waiting to shake hands, was, "Jack, why did you seal it"? After being advised of the conditions by inspectors and the others present he said, "Well, it seems to be the only thing to do but I hate to do it because we have never sealed a mine in West Virginia, during the time I have been chief, while there were any men in the mine, alive or dead. We have always gotten them out." He would not be satisfied, however, without having a look himself so, accompanied by Lambie, Jack Berry of the Bethlehem Mines Corporation and two of their rescue teams, we returned to the seal on No. 1 entry and erected a temporary air lock. It was decided that Lambie, Berry and I would wear gas masks and explore as far as we could in order to save the rescue crews, and if we were stopped through lack of oxygen or an explosive gas mixture, then the rescue crews could make further and more extensive explorations—the objective being to get some air samples far enough inside the seals which would not be influenced by leakage, so as to determine the actual condition of the atmosphere; also to try and find the fire or to at least approximately determine the section in which it was located. On completion of the air-lock we donned masks and Lambie proceeded first through the inside seal, but before we had time to get through the seal Lambie stopped us and said, "This is far enough. I have the gas right here." He estimated that it was about 4 percent. Berry and I then stepped inside with the masks and took a vacuum sample which, on analysis a short time later on the outside, showed 3.6 percent CO_2, 13.8 oxygen, 3.3 carbon monoxide and 4.4 percent methane. This combination of methane and carbon monoxide is probably explosive if sufficient oxygen is present, and 13.8 percent oxygen is about on the questionable line. In other words, this atmosphere with a source of ignition present, such as fire, would probably cause an explosion.

The rescue crews were then sent in to this section indicated by the shaded zone on the map, and they made a rather careful exploration of the mouths on the No. 2 Southwest entries and up these entries for a distance of 300 or 400 ft., or as far as they could go on account of the very smoky atmosphere. A sample was taken at the mouth of No. 1 butt which holes through to No. 3 South entry. This sample, when analyzed, showed 3.8 percent CO_2, 11.4 percent oxygen, 4.4 percent CO and 3.44 percent methane. This is the highest percentage of carbon monoxide we can find recorded, other than in the experimental mine, immediately following a mine explosion. This mixture, however, would not propagate an explosion because there is not sufficient oxygen, and as the rescue team reported that the smoke was coming from some point further in the 2nd or 3rd South entry, we were reasonably sure that the oxygen content in the vicinity of the fire would be less than in this sample and that if we could keep any appreciable amount of oxygen from getting in to that section it would be safe to proceed with the work.

From that point on we violated most of the rules laid down by Mr. Forbes in the very excellent paper which he has just presented, with respect particularly to keeping a section sealed and not reopening it until the oxygen content and the CO content are both down to practically zero. These suggested rules of procedure by Mr. Forbes are excellent and should be followed ordinarily, but there are exceptions to all rules, and surrounding conditions must be taken into account in developing procedure. This was an unusual case, with all these

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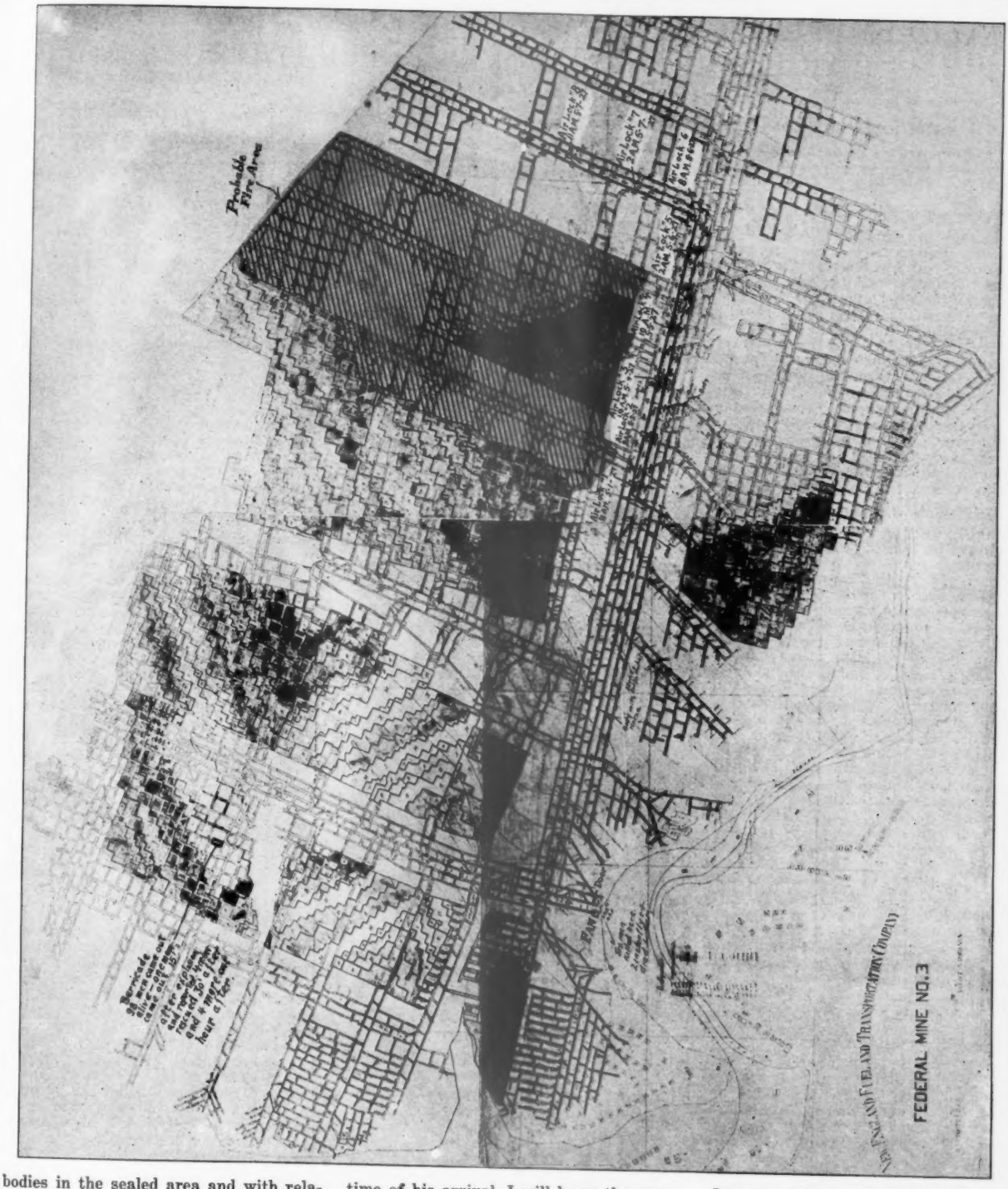

bodies in the sealed area and with relatives and friends of these men on the outside still hopeful that there was a chance for some of them being alive. After receiving the report of the sample which showed 4.4 percent carbon monoxide some 400 or 500 ft. from the seals we knew that there was no chance of anyone being alive and it would be foolish to proceed with a plan that would probably result in another explosion that might kill 100 more men.

Mr. Lambie follows later on this program, and as the recovery work was entirely under his direction after the time of his arrival, I will leave the map here and I think you will be interested in having him tell you about the conduct of the work from that point on, which included, first, the sealing of the fire area and recovery of the bodies and, more particularly, the organization he perfected which functioned perfectly. The sealing of the fire area was done entirely with breathing apparatus and there were 19 rescue teams engaged in the work. During most of the time the work was being conducted, the margin of safety from another explosion was very slight.

Jerome Watson, Chief Mine Inspector of Ohio, reports that all fire bosses who serve in Ohio mines after December 31, 1927, must hold a first-class certificate, to be obtained by passing an examination. These examinations are to be given by the deputy inspectors. There will be two classes of foremen or bosses. First class foremen must all pass an examination given by the Department of Mines. Second class foremen can be licensed without an examination upon recommendation of the operating company.

SAFETY APPLIANCES AND ACCESSORIES USED IN MINE FIRE FIGHTING AND RECOVERY OPERATIONS

Ventilation And Fire Fighting Becoming Complex As Workings Extend—Safety Appliances And Accessories Classified—Rock Dusting Equipment Described—First Aid Supplies Listed—Control Of Mine Gases Becoming A Science

By EDWARD STEIDLE *

MINE fire fighting and recovery operations are thrilling stories of generalship and soldiering, as well as engineering. A broad mechanization program is under way in American coal mines as the workings grow deeper and more extensive, consequently, ventilation and fire-fighting problems are more complex. Scientists and manufacturers, working hand in hand during the past 10 years, have invented and developed appliances which make it possible to carry on fire-fighting and recovery operations in a systematic manner. The object of this paper is to classify and describe briefly the safety appliances and accessories in use today that make this hazardous work safer and more effective.

DANGEROUS GASES IN COAL MINES

Dangerous gases in coal mines encountered in fire-fighting and recovery operations may be placed in three groups: (1) those that are explosive; (2) those that are toxic; and (3) atmospheres that do not contain sufficient oxygen (O_2) to sustain life. Methane (CH_4) is the important gas of the first group, and in so-called gassy mines it constantly exudes from the coal and rock; it may accumulate and form an explosive mixture. Hydrogen gas (H_2) should be mentioned as it is sometimes found in fire areas. The common toxic gas is carbon monoxide (CO), a product of incomplete combustion that is always associated with mine fires, and is one of the dangerous constituents of afterdamp following explosions. Oxides of nitrogen and hydrogen sulphides (H_2S) are toxic but are seldom found in dangerous quantities in coal mines. Sealed fire areas are largely devoid of oxygen and usually contain a mixture of all of the gases just enumerated.

Carbon dioxide and humidity sometimes seriously complicate ventilation problems, but will not be discussed at length in this paper.

Methane: From a practical point of view all coal mines are potentially gassy. However, coal mines are now designated by the various State Inspection Departments as gassy or non-gassy for purposes of regulation in respect to the prevention of explosions and fires. For example: the Pennsylvania bituminous mine law provides in general that any mine which generates explosive gas in a quantity sufficient to be detected with an approved safety lamp is a gassy mine. This does not apply to mines generating explosive gas only in live entries. Furthermore, if no explosive gas is detected by means of an approved safety lamp within one year a mine may be termed non-gassy, according to the judgment of the mine inspector.

The explosive range of methane-air mixtures is well defined. Approximately, the low limit is 5 percent, the high limit 15 percent, and the most explosive mixture 10 percent methane. Any amount of methane in mine air increases the inflammability of coal dust, and 0.5 percent will materially increase the rate of propagation of coal-dust explosions.

Carbon Monoxide: Carbon monoxide is explosive, but the lower limit is about 12.5 percent in normal air, but when this percentage of carbon monoxide is present in mine air, the oxygen content is not sufficient to support an explosion. On the other hand, carbon monoxide is highly toxic, and an explosive mixture would cause almost immediate death to a person breathing it. The presence of carbon monoxide in mine air may also be associated with spontaneous oxidation of coal, and its presence above certain normal values must be considered as an indication that heating of some kind is taking place in some part of the mine.

Fig. 1—McCaa self-contained oxygen breathing apparatus

Fig. 2—All service gas mask

Carbon monoxide has an action on human beings which is peculiar to itself. When inhaled it comes into contact with the blood brought to the lungs and unites chemically with hemoglobin, the oxygen-carrying constituent of the blood. After this chemical combination has taken place, the individual who has inhaled the gas is deficient in oxygen, through impairment of the oxygen-carrying capacity of the blood, just as much as though the same amount had been lost by the opening of one of the blood vessels or his supply of air had been shut off. A few inhalations of air containing 2 percent of carbon monoxide will cause unconsciousness and death in three or four minutes. Death is likely to occur when a man breathes air containing as low as 0.2 percent of carbon monoxide for from two to four hours. As a matter of fact, relatively long exposures to any percentage above 0.01 percent must be regarded as unhealthful or dangerous, and particularly during vigorous exertion, when the volume of breathing is greatly increased, and consequently saturation of the blood with carbon monoxide is more rapid. The U. S. Bureau of Mines has recently defined the permissible limits of carbon monoxide in vehicular tunnels as 0.04 percent for one hour, and in mines at 0.01 percent.

Oxides of nitrogen and hydrogen sulphide are toxic gases but are seldom found in dangerous quantities in coal mines.

Vitiated Air: Ordinarily, air consists of about one part (or volume) of oxygen to four parts of nitrogen, or 20 percent oxygen and 80 percent nitrogen. Nitrogen is an inert gas and takes no part in supporting life or combustion. Oxygen is the important constituent, because without it there can be no life or combustion. Air that contains only 18 percent of oxygen causes deep breathing, 12 percent causes heavy breathing, and air containing less than 10 percent may cause death. In experimental tests when the percentage of oxygen is slowly reduced, men at rest have lived in a mixture of 4 percent oxygen and 95 percent nitrogen, but this is purely of scientific interest. Sealed fire areas sometimes contain less than 1 percent of oxygen which will cause paralysis of the respiratory organs and instant death to anyone breathing the atmosphere, irrespective of the toxic gases which may be present.

CLASSIFICATION OF SAFETY APPLIANCES AND ACCESSORIES

Tables 1 to 11 classify the safety appliances and accessories now on the market for use in fire-fighting and recovery work. Some of the equipment classified is too well known to need lengthy explanations, but the newer devices, together with their field of use, will be described in greater detail. Con-

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ditions vary and emergencies arise which make it impossible to differentiate the appliances used in any particular phase of operations. The term "permissible" is used in the tables and in the discussion following. This, of course, applies to those apparatus and devices tested and approved by the U. S. Bureau of Mines as permissible for use in coal mines.

Illumination and Respiratory Equipment

Tables 1 and 2 classify the lighting equipment and respiratory apparatus recommended.

All-Service Gas Mask: The all-service gas mask (see figure 2) is the only commercial mask which gives protection against all industrial and mine gases. During the collegiate year 1923-24, Carnegie Institute of Technology, the U. S. Bureau of Mines, and the Advisory Board of Mine Operators and Engineers in Western Pennsylvania at Pittsburgh, carried on a cooperative investigation regarding the use of this mask in fighting mine fires and in exploration and recovery work following mine explosions. This investigation showed conclusively that gas masks of this type are the most efficient, economical, and satisfactory protection known at the present time in at least 75 cases out of 100, but it must always be used in conjunction with a flame safety lamp. Self-contained oxygen breathing apparatus may now be considered auxiliary equipment. On the other hand, gas masks are useless in atmospheres largely devoid of oxygen (below 16.5 percent) and have very little application in unsealing mine fire areas. Self-contained oxygen breathing apparatus is the only safe respiratory apparatus to use in exploring sealed fire areas.

Devices for Detecting Methane

The selection of an appliance to detect and determine the percentages of methane in mine air primarily depends upon the following factors: (1) lower limit of detection; (2) accuracy; (3) desirability of sampling and analyzing in the mine; (4) operator; (5) examination required for other gases; (6) speed of manipulation, and (7) continuous or intermittent record.

All of the devices excepting the flame safety lamp depend upon burning the gas out of the sample; the decrease in volume is an indication of the percentage of methane present. Table 3 lists the permissible devices in use.

Magnetic-Locked Flame Safety Lamp: The principal function of a flame safety lamp since the advent of the electric cap lamp is to indicate the presence of methane in mine air. Safety lamps must be kept in perfect condition and should be charged with the best obtainable fuel. All lamps should be kept and repaired in the lamp-house, which should be in charge of a reliable, well paid employe. No lamp other than those kept in the lamp-house should be allowed underground. A full-size round or flat-wick lamp is best for inspection purposes. The flame safety lamp should not be used in the return from fire area when seal is broken and area ventilated.

The Bureau of Mines states that the length of the gas cap formed over a non-luminous flame of a Wolf round-wick lamp when 1 percent of gas is present is about 0.3 inch., and many men claim that they can easily and accurately detect this percentage. This is doubtful, because it is easy to be misled unless one is extremely careful to differentiate between the "fuel" cap, which is constantly formed, and the gas cap. It is doubtful, considering all the variables, whether less than 2 percent of methane can be detected effectively. This percentage gives a cap about 0.4 inch high.

Burrell Indicator: The Burrell gas indicator (see Figure 3) was designed in 1915 to detect lower percentages of methane in mine air than can be detected by means of a flame safety lamp and in places where such a lamp should not be used. The instrument will detect as low as 0.1 percent of methane. It consists essentially of a "U" tube, one side of which is glass and the other brass. A scale, graduated to read percentages of methane, is attached to the glass tube. On top of the brass tube is a valve through which a sample of mine air is drawn, and in the tube is a small coil of platinum that has terminal connections on the top of the tube.

When used, the instrument is filled with water to a mark. A sample of mine air is drawn into the instrument at any point in the mine as desired, and the current from the battery of an electric cap lamp is then switched on. The current causes the platinum coil to be raised to a high temperature, sufficient to burn the methane in the sample. If methane is present there will be a decrease in volume of the air sample after the burning and cooling, and the water will rise in the brass tube, causing a much greater drop in the water level of the smaller glass tube. The glass tube is calibrated in terms of methane and results are obtained direct from the scale.

The Burrell indicator is simple and can easily be used by anyone after a few determinations. Only five minutes is required to make a complete test.

Methane Continuous Recorder: A perfected methane recorder (see Figure 4) was shown for the first time at the last coal convention of the American Mining Congress at Cincinnati, May 24 to 28, 1926, and is epoch-making in respect to coal-mine ventilation. It can be made flame proof and will provide an accurate,

TABLE 1—PERMISSIBLE LIGHTING EQUIPMENT

Lamp	Illumination	Field of use	Remarks
Electric cap lamp (Edison, Ceag, Wheat, etc.).	6-10 candle power, head on.	Illumination, apparatus crews, workmen.	Recommended for general illumination.
Electric hand lamp (Edison, Ceag, Everready, etc.).	6-10 candle power, head on.	Close inspection, map readings, etc.	Use limited.

TABLE 2—PERMISSIBLE RESPIRATORY APPARATUS

Apparatus	Type	Field of use	Limitations
Gibbs, Paul, * McCaa.	Self-contained, oxygen breathing.	Vitiated air, fire fighting, exploring sealed fire areas, recovery operations.	2-4 hours. Wearer must be trained and physically fit.
† Salvas, † Atmos, † McCaa.	Self-contained, oxygen breathing.	Vitiated air, limited for mine use.	½-1 hour. Wearer must be trained and physically fit.
All-Service gas mask.	Gas absorbing canister.	Irrespirable air (including carbon monoxide), containing 16.5 percent or more of oxygen. Fire fighting, recovery operations following explosions.	2 hours. Must be used in conjunction with flame safety lamp. Training and physical fitness desirable.
Self-rescurer.	Gas absorbing canister.	Worn on belt of all inside men for emergency protection against carbon monoxide and smoke only.	½ hour.

* See Figure 1. † Not approved—No schedule to cover at present.

TABLE 3—PERMISSIBLE DEVICES FOR DETECTING METHANE

Appliance	Lowest percentage detectable	Field of Use	Remarks
Magnetic locked flame safety lamp (Wolf, Kohler, etc.).	1.0-2.0	General inspection out-by fire area stopping and during recovery operations by mine inspectors and officials in charge only.	Roughly quantitative, depending on lamp, fuel, and operator. Not to be used within sealed area, locks or return from fire area when seal is opened.
* Portable methane analysis apparatus.	0.25	Engineer, chemist, analysis for methane only.	Accuracy depends on laboratory technique of operator.
* Portable gas-analysis apparatus.	0.2	Engineer, chemist, complete analysis of samples of return air, fire areas, recovery operations, etc.	Accuracy depends on laboratory technique of operator.
Burrell indicator.	0.1	Inspection in vicinity of fire area and return from fire area when seal is opened; also recovery operations.	Fairly accurate in trained hands.
* Continuous recorder.	0.01	Fan house, return air from fire area, recovery operations, etc.	Accurate and automatic.

* Not approved for permissibility.

continuous record of the amount of methane in any current or split of air, and serves as a guide for adjusting regulators or the speed of the fan so that the volume of air supplied to any split may be sufficient to maintain proper ventilating standards.

An electrically-driven pump draws the air sample into the instrument. The sample first passes through a purifying chamber, which removes dust and solid particles, and then through a canister filled with chemicals for removing any moisture or carbon dioxide which may be present. The sample next passes through a temperature equalizer and then a flowmeter which maintains a constant head or pressure in forcing the sample through an orifice 0.014 inch in diameter. The pressure is regulated to force a ½ liter sample through the orifice per minute; any excess is bypassed to the outside air. This ½ liter then flows through a fused-silica tube which is heated to a temperature of about 800°C. by means of an electric furnace. The effect of the temperature serves to oxidize completely to carbon dioxide and water any methane which is present. These products are absorbed when the sample passes through a second canister.

Thus by removing the products of combustion of the methane there is a contraction in the volume of the sample equivalent to three times the volume of the methane originally present. The remainder of the sample is led through the temperature equalizer which brings it back to the original temperature, and is then forced through a second orifice of exactly the same diameter as the first one. If no methane is present the volume will remain constant, and the pressure required to force it through the second orifice will be identical with that of the first orifice. If methane is present the pressure required to force the reduced volume of the sample through the second orifice is correspondingly lower. This difference in pressure is recorded by means of a sensitive pressure recorder on a chart calibrated to read percentages of methane direct. The chart covers a range of from zero to 2 percent methane, and can be accurately read to 0.01 percent. The chart shows the exact amount of methane present in the ventilating current at any minute of the day. The chart is renewed and filed daily, and the absorbing chemicals in the two canisters are renewed weekly. No other attention is normally required to keep the instrument in continuous service. The continuous methane recorder has passed the experimental stage; the laboratory research work has been supplemented by an actual installation for several months in the fan-house of one of the large operations in the Pittsburgh district.

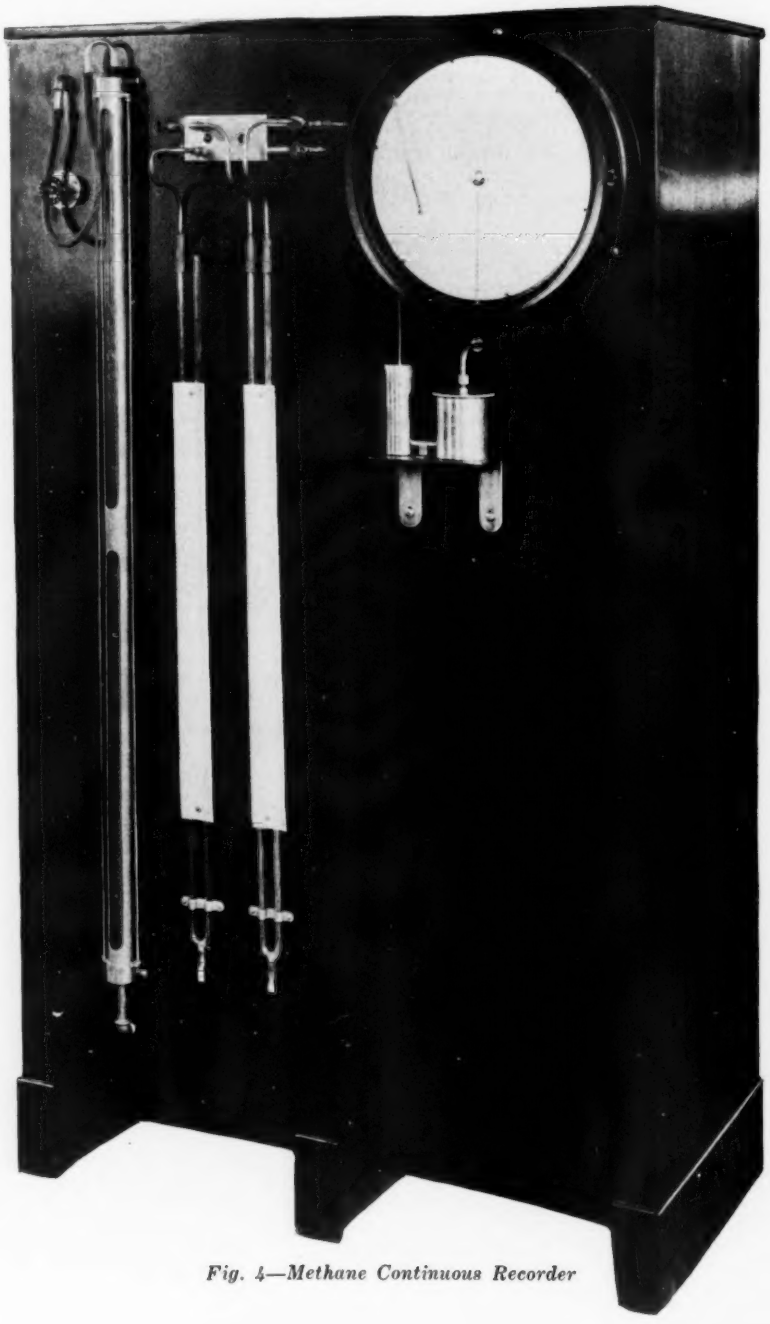

Fig. 4—Methane Continuous Recorder

Carbon-Monoxide Detecting Devices

The factors involved in the selection of a device for detecting carbon monoxide in mine air are quite similar to the factors just enumerated. With the exception of the canary bird, the devices for detecting carbon monoxide depend, in the order named in the classification, upon (1) the reducing action of carbon monoxide; (2) the affinity of carbon monoxide for the hemoglobin of the blood; (3) contraction in volume due to combustion or absorption; and (4) the heat liberated incident to the oxidation of carbon monoxide. Table 4 lists the devices in use.

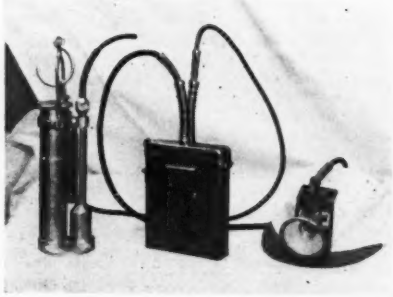

Fig. 3—Burrell Indicator

Fig. 5—Carbon-Monoxide Detector

Fig. 6—Pyrotannic Detector

TABLE 4—DEVICES FOR DETECTING CARBON-MONOXIDE

Appliance	Lowest percentage detectable	Field of use	Remarks
Canary bird.	0.1-0.15	Out-by sealed area stoppings and recovery operations.	Roughly quantitative, depending on bird and length of exposure.
Portable gas-analysis apparatus.	0.2	Engineer or chemist, samples of fire gases, sealed area, etc.	Accuracy depends on laboratory technique of operator.
Carbon monoxide detector (Hoolamite).	0.07	General recovery work, fire fighting, exploration.	Fairly accurate depending on ability to read color scale.
Pyrotannic detector.	0.01	Engineer, recovery work, fire fighting, explorations, etc.	Accurate in trained hands.
Continuous recorder.	0.0004	Fan house—spontaneous oxidation, combustion, etc.	Accurate and automatic.

Fig. 7—Carbon Monoxide Continuous Recorder

Carbon-Monoxide Detector: The carbon-monoxide detector (see Figure 5) was designed in 1921 to determine the presence of carbon monoxide in dangerous proportions. The operation of the device is very simple and it is now considered a standard mine-rescue and fire-fighting appliance. The detector tube used with the instrument is filled with a chemical which changes color when air containing carbon monoxide is passed through it. The shade of the color (bluish-green) varies with the concentration of carbon monoxide. By comparing this with the standard color scale, which is included with the instrument, not only the presence but the approximate amount of carbon monoxide in the air under test can be quickly determined. About 0.07 percent can be easily detected with the device. The barrel of the instrument is filled with activated charcoal, which absorbs any other gases in the atmosphere that might effect the chemical in the detector tube. Ten squeezes of the bulb are all that is needed to make a test. The color produced in the detector tube soon fades upon standing, thus permitting its reuse for seven or eight ordinary tests, when it should be replaced with a new tube.

The advantages of the carbon-monoxide detector over the canary are: (1) it will detect a smaller percentage; (2) it gives almost immediate results; and (3) the operator knows at all times whether carbon monoxide is present and approximately the percentage. When 0.2 percent carbon monoxide is encountered by a rescue crew wearing breathing apparatus or approved gas masks the canary is no longer available and the crew either has to return with it to fresh air or it dies, and in either case, is no longer available for advance exploration.

Pyrotannic Detector: The pyrotannic method (see Figure 6) of detecting carbon monoxide was devised in 1921. It is based on the same principle and reactions as those which take place when carbon monoxide poisoning occurs, namely, the combination of carbon monoxide with hemoglobin of the blood. Hence, it may be regarded as a specific test. The blood examined may be either that of a victim of supposed carbon-monoxide poisoning, in order to verify the diagnosis; or carbon monoxide may be detected in the air by collecting a sample of the air and introducting a small amount of non-poisoned blood solution into the sample container. In the latter case the combination of carbon monoxide and hemoglobin will take place in a manner similar to that which has been described as taking place in the lungs, and an examination of this blood

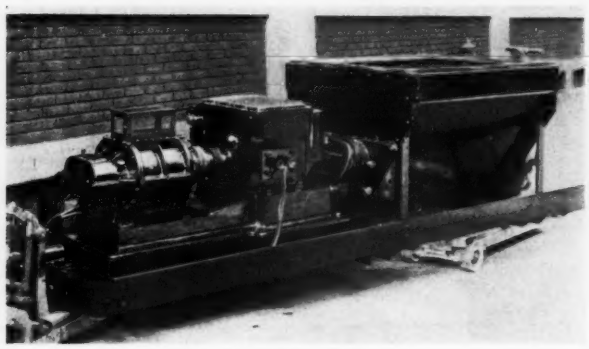

Fig. 8—High pressure rock dust distributor

Fig. 9—Mine fire truck

will reveal whether or not carbon monoxide was present in the air to which it was exposed.

A grayish brown suspension will form in a few minutes after treatment of normal blood solution with a mixture of tannic and pyrogallic acid, whereas when the blood is combined with carbon monoxide it will be faint to deep red, depending upon the degree of poisoning.

By preparing color standards to represent certain degrees of poisoning, the unknown samples of blood may be matched to the color of these standards and the amount of carbon monoxide ascertained. Only a small amount of blood solution, 0.10 c.c., or two or three drops of blood diluted with 2.0 c.c. of water, is required for an analysis; the blood is obtained by pricking the finger slightly with a small lancet furnished with the apparatus. In cases of supposed poisoning, the blood solution is transferred to a small test-tube and treated with the tannic and pyrogallic acids.

The procedure for examining mine air by this device is to collect approximately 250 c.c., or one-half pint, sample of gas, introduce 2.0 c.c. of the blood solution into the bottle, close the latter and agitate by rotation for about 10 minutes. During this agitation the reaction between the hemoglobin of the blood and the carbon monoxide will take place, after which the blood solution is drained into a small test-tube, and a small amount of the tannic and progallic acid added. The tube is inverted a few times to mix the blood and acids, after which it is allowed to stand 15 minutes and comparison made with the standards.

This device may be used to determine accurately carbon monoxide from 0.01 to 0.20 percent. Thus it covers the range of concentrations from those which produce no appreciable effect after several hours, to those which will cause headache, nausea, dizziness, collapse, and death. Carbon monoxide higher than 0.20 percent will be indicated at 0.20, or a dangerous atmosphere.

This device is very useful for determining accurately the presence or absence of carbon monoxide in air collected from behind fire seals, thus giving information regarding the condition of the fire. These traces, which are very significant, are difficult to determine with the desired accuracy by the usual methods of gas analysis.

Carbon-Monoxide Continuous Recorder: Probably the greatest contribution in recent years in the field of devices for detecting dangerous gases has been the carbon-monoxide recorder (see Figure 7), which was perfected and placed on the market in 1925.

The fundamental principle of the device is based on the measurment of heat developed in the catalytic oxidation of carbon monoxide by "Hopcalite." The heat liberated in this oxidizing process is directly proportional to the amount of carbon monoxide present and is measured by a thermometer or a unit of thermocouples wired to a recording potentiometer. The chart of the potentiometer is calibrated to read carbon monoxide direct with a sensitivity of two ten-thousandths of 1 percent, or two parts per million of carbon monoxide. In its present form the apparatus represents the combination or assembly of various ideas and devices developed through a period of eight years to meet the demands of war, industrial, and mine gas emergencies. The instrument has special application in mining operations for the detection of spontaneous com-

TABLE 5—DEVICES FOR DETECTING OXYGEN DEFICIENCY

Appliance	Lowest percentage detectable	Field of use	Remarks
Approved magnetic locked flame safety lamp (Wolf, Kohler, etc.).	16.5-17.0	General inspection out-by fire area stopping by mine inspector and officials in charge only.	Roughly quantitative depending on lamp, etc.
Portable gas-analysis apparatus.	0.2	Engineer, chemist, sealed fire area, etc.	Accurate, depending on laboratory technique of operator.

TABLE 6—INSTRUMENTS OF PRECISION

Apparatus	Field of use	Remarks
Minimum and maximum thermometer.	Temperature determinations in sealed fire areas.	Locating spontaneous combustion, smoldering fires.
Barometer.	Recording barometric pressures which govern exudation of methane.	Pressure within sealed fire area depends on barometric pressure.
Sling psychrometer.	Measuring relative humidity.	Scientific interest mostly.
Anemometer.	Air measurements.	Fairly accurate.
Water gage.	Determining ventilation pressure.	Accuracy depends on ability to read scale.

TABLE 7—DEVICES FOR SAMPLING MINE GASES

Method	Field of use	Remarks
Water displacement, (bottle, burrett, metal container).	Sampling within locks, fire area, recovery operations.	Fairly accurate; suitable for quick analysis.
Vacuum tube.	Sampling within locks, fire area, recovery operations.	Accurate; proper method if sample is transported.
Aspiration bulb.	Sampling within locks and through fire area, stoppings, etc.	Fairly accurate; suitable for quick analysis.
McCaa Sampler.	Sampling through fire area stoppings, irrespective of pressure within area.	Fairly accurate.

TABLE 8—GAS-ANALYSIS APPARATUS

Type	Percentage and gases determined	Field of use
Portable methane analysis apparatus.	0.25 methane (CH_4)	Ventilation, locks, fire area, recovery operations; for methane only.
Portable gas-analysis apparatus.	0.2 Oxygen (O_2) 0.2 Nitrogen (N_2) 0.2 Carbon dioxide (CO_2) 0.2 Carbon monoxide (CO) 0.2 Methane (CH_4)	Ventilation, locks, fire area, recovery operations for all common mine gases.
Laboratory gas-analysis apparatus (Haldane).	0.01-O_2-N_2-CO_2 CO-CH_4	Same as above but used mostly for laboratory studies.

Fig. 10—H-H Inhalator

bustion or mine fires in their incipient stage. It can be installed on the main air return.

Other Devices and Instruments

Tables 5, 6, 7, and 8 list devices for detecting oxygen defficiency and sampling mine gases, and instruments of precision and analytical apparatus.

In Table 8, the first mentioned apparatus is designed for mine use, and will measure as low as 0.25 percent of methane. The portable gas-analysis apparatus will analyze mine air for all common gases, such as methane, carbon monoxide, carbon dioxide, oxygen and nitrogen. It will measure 0.2 percent of carbon monoxide as well as methane, and is likewise effective for the other gases mentioned. It can be taken underground when fires occur, set up and operated in the mine foreman's office, for analyses other than methane. The Haldane laboratory gas-analysis apparatus is not portable but a skillful manipulator can determine as low as 0.01 percent of methane, carbon monoxide, and the other common mine gases.

TABLE 9—ROCK-DUSTING MACHINES AND ACCESSORIES

Apparatus	Field of use	Remarks
Rock dust distributors* (LeGrabon, †M. S. A.)	General dusting, out-by fire area stoppings, etc.	Strongly recommended.
Rock-dust barriers (concentrated or trough type).	Erected at strategical points.	An added safety measure.
Rock dust.	General dusting, fighting fires, etc.	Preferably limestone or kaolin. Illumination effect an added advantage.
Rock-dust sampling.	To determine percentage of inert dust present.	60 percent or more of rock dust should be present, depending on relative inflammability of coal dust.

* Approved for permissibility. † See Figure 8.

TABLE 10—MISCELLANEOUS EQUIPMENT AND ACCESSORIES

Apparatus	Field of use	Remarks
Fire truck (M. S. A.).	Fighting underground mine fires.	Indispensable mine equipment.
Fire extinguishers (Acid type—Foamite).	Extinguishing smoldering fires, emergency. Not electric fires.	Do not generate poisonous gases when used on fire. Carbon tetrachloride should be used on electric fires, but ventilation must be adequate.
Copper hammer and nails.	All construction work in fire area.	Should not strike sparks.
Life line.	Exploration crews (limited to 500 feet).	For giving signals. Indispensable if crew is unfamiliar with mine workings.
Map.	Affixing pertinent data covering field of operations.	Large scale, up-to-date map of mine showing returns from affected section.
Chalk.	Exploration crews.	Indispensable.

TABLE 11—APPROVED FIRST-AID SUPPLIES

Equipment	Field of use	Remarks
Miners' first-aid kit.	Accidents, first-aid dressings.	Keep in accessible first-aid station.
First-aid packet.	Accidents, emergency dressings.	Carried by all inside men.
Stretcher and blanket kit.	Accidents, shock, asphyxiation.	Keep in accessible first-aid station.
Inhalator, 95.5 percent mixture of oxygen and carbon dioxide (carb-oxygen) H-H Inhalator, Atmos, Industro Oxygenerator — Universal Model).	Asyphxiation.	Same as above—to supplement Schaefer prone-pressure method of artificial respiration.

Rock-Dusting Machines and Accessories

The value of rock dust to render inert the coal dust in mines and so prevent or limit explosions is undisputed by all but the most biased and unenlightened persons. Within two years possibly 2,000 lives have been saved because mines in which local ignitions occurred, had been rock-dusted. Rock dust is also useful at time of fires and Table 9 lists some machines and accessories for its distribution, etc. Both of the machines listed are giving good service; the former is of the fixed nozzle type and the latter of the flexible nozzle type. It is understood that one manufacturer has built a high-pressure distributor that will deliver 120 pounds of rock dust per minute through about a 500-foot length of 3-inch fire hose. A distributor of this type will be advantageous for dusting back entries and rooms, and for fighting fires by the direct method.

Miscellaneous Equipment

Table 10 lists sundry equipment, some of which is described later.

Fire Truck: The M. S. A. mine fire-fighting truck (see Figure 9) is being exhibited for the first time at this convention of the American Mining Congress. The American-La France Fire Engine Co. featured a mine fire-fighting truck about 15 years ago and a number were put in service. This company, however, did not have close contact with the coal industry and as the municipal business grew it left the mining industry entirely.

The new truck will be equipped with two 35-80-gallon soda and acid extinguishers, two hand extinguishers, a hose basket with 200 ft. of ¾-in. chemical hose, two nozzles, five All-Service gas masks, one carbon-monoxide detector, one portable searchlight, and extra soda and acid receptacles. The trucks will be on roller bearings so that the car can be pushed by hand to any section of the mine in the event of the electric power being off. The extinguishers, hose and accessories will be of the American-La France type. It is readily appreciated that a fire truck of this character will be an invaluable as well as indispensable piece of mine equipment. If a fire is discovered early, it can be extinguished without unnecessary delay, thus eliminating sealings.

First-Aid Supplies

Table 11 lists some necessary supplies for caring for injuries that may occur in fire-fighting and recovery operations.

H-H Inhalator: Physiologists now agree that in asphyxiation, especially carbon-monoxide poisoning, the Schaefer prone-pressure method of artificial respiration should be supplemented by the use of an inhalator which will pour a 95.5 percent mixture of oxygen and carbon dioxide into the lungs, it being recognized that a rich oxygen mixture is doubly effective in purifying the blood and a small percentage of carbon dioxide will stimulate breathing.

The H-H Inhalator (see figure 10) is mostly in use, and consists essentially of a steel cylinder containing a 95.5 percent mixture of compressed oxygen and carbon dioxide. This mixture passes through a reducing valve and a low-pressure regulating valve into a breathing bag, and thence through a chamber containing a check valve and a fresh-air valve. (*Continued on page* 530)

PREVENTION OF, FIGHTING AND SEALING MINE FIRES

Fires May Be Prevented By Proper Supervision And Strict Discipline—Each Fire Presents Own Peculiar Problem Permitting No Fixed Rule In Fighting—When Unsealing, Well Thought Out Plan Should Be Outlined In Writing And Strictly Adhered To

By F. B. DUNBAR*

ALL mining men should be interested in this question of sealing and unsealing mine fires so ably presented by Messrs. Forbes and Steidle. Officials realize that nothing is more hazardous than a mine fire, and that the extent of the fire is not a measure of the hazard. A small fire may cause an explosion.

While we are interested in knowing how to combat a fire, and how to unseal a fire area, we are also interested in the prevention of fires.

Many fires can be prevented by proper supervision and strict discipline. Observance of the following preventatives will reduce the fire hazard:

Proper installation of trolley wire.
The use of proper size of trollev wire.
Spacing hangers properly.

Removing all hangers developing a ground. A defective hanger will leak and cause an arc. A hanger may become defective from corrosion, or an accumulation of either coal dust or rock dust may cause it to leak. A good practice is to brush the hangers immediately after rock dusting.

Hangers should not be placed in overcasts.

Wires should be placed so that they will not come in contact with door frames and doors.

Doors in entries should not be placed over the joint of the rail.

All tracks should be double bonded, especially where gathering locomotives are used.

Trailing cable should be of the double conductor type, and the negative terminal of the cable should be connected at all times with the return circuit when the cables are being used.

Proper wiring of stationary motors and maintaining the wire on electric locomotives in first-class condition.

The abandonment of worn-out machine cable.

Switches for light and power circuits should be placed on the outside of underground buildings. That is so officials may observe them as they go by. It is customary for men to put the light in your assistant foreman's office inside the building where frequently you have an electric heater. Fires have occurred, due to electric heater not being turned off or something falling down on it. If the switch is placed on the outside of the building, you can observe that that switch has been pulled and fire probably prevented.

A light signal should be placed on the butt entry where officials can see it, and if the light is burning the official will know that the butt entry switch has not been pulled. This light should have a green globe.

Removing rail or old wire rope from gob workings.

All permanent buildings underground should be fireproof and equipped with iron doors which open outward.

When you abandon a section of a mine, if you have an old cable lying there, or an old pipe line you figure is not worth taking up, be sure the ends of that pipe or rope are away from your used track, as a defective current may leak on through there and cause a gob fire.

Proper handling of explosives by competent shotfirers and others.

The management should provide and insist upon a fire run on idle days and Sundays. When you get into a depression, you get after your management to cut down their expenses and the first thing you do is to drop the night foreman or cut the fire boss off on the idle days; you don't make your fire run after six days' work is over, or you don't make it on Sunday, and the first thing you know you have a fire.

Examining all underground employes for matches and other smokers' articles, this examination to take place at the ground landing before the men enter the mine. Proper supervision and strict discipline will reduce the fire hazard to a minimum. Pick these men at random off in each cage load, and thereby you put the fellow in mind that he may have a match on his person, not remembering it. This I consider is one of the greatest fire hazards that we have to contend with. I want to say, personally, that we do not hesitate to prosecute any man, whether it is due to lack of memory or otherwise, when he is carrying matches or smokers' articles.

The fighting of fires is attended by great difficulties, as fires occur without any warning, and the officials do not have time to plan a method of procedure. They fight the fire with every means available, using hand chemicals, water (if available), rock dust, and chemical engines. They should consider the sealing of a fire only as a last resort.

When a fire is discovered, the first duty of the management is to get the men out of the mine as quickly as possible, except those engaged in fighting the fire.

Officials who have gone through the experience of fighting and sealing fires realize the necessity of having an abundance of material and equipment on hand, and insist upon keeping back-up tile, cement, and sand available for such emergencies. We set aside that material and built a fence around it. It must not be used excepting in an emergency or a fire.

No fixed rule can be established for fighting fires, as each fire presents its own peculiar problem, and the method of fighting the fire will depend upon the area affected, the method of ventilation, the character of the coal (whether high or low volatile), and the character of the roof (whether it is shale, anthracite, bituminous, or cannel coal). A local fire can be fought longer than a high volatile fire. In one particular fire we had about 24 ins. of roof and the fire spread rapidly and with an intensity that you would hardly realize.

The officials should have on hand the necessary tools for building temporary and permanent stoppings. Personally, I prefer to use back-up tile for temporary work. They can be laid quickly, using a mortar made from common clay, and plastering the tile by throwing mortar with a shovel or using a trowel. The fire occurred in the right side of this mine a number of months before. The thing that we were short of, of all the materials, were trowels. Think of it! We could not get sufficient trowels. We had the men and the material, but we did not have the trowels and we did not have the time necessary to seal it up very rapidly. To overcome that, we now have a box with trowels, picks and shovels, axes and canvas gloves. We keep all of that material locked for fire emergency.

In building the permanent stoppings brick should be used, with good cement mortar, with a channel cut in the roof through loose strata and a channel cut through the bottom coal or fireclay down to bed rock. This stopping should be constructed with a tile center, 2 ft. square, as these permanent seals will be knocked down some time in the future. Very often it is necessary to build a second permanent seal, especially if there is a high-water gauge to contend with. They are getting to call that the Dunbar stopping. If it is constructed with 2-ft. tile center, you can knock it out rapidly in unsealing the fire or entering the fire zone.

An official should be on duty to make rounds, examining the seals and plastering them as leaks develop. As the atmospheric pressure changes, breathing will take place, and I do not know of a case where permanent seals were absolutely airtight.

Air locks should be constructed and pipes placed so that temperature readings and pressure readings, as well as samples, can be taken. In contructing the air lock the careful manager will keep in mind that the air locks can be used for unsealing, which will allow of making doors large enough to admit a stretcher and at least an apparatus crew with an official. Very often this matter is not given due consideration.

The question as to whether the intake or return should be sealed first has not been settled, and I do not believe it ever will be. Each experienced official has his ideas as to the method of sealing a fire, and all as a rule are successful.

The careful manager will not be influenced by the sales department in placing the mine in operation without taking sufficient time to make sure that the seals are placed properly, and analyze the air and know that conditions underground are safe enough to warrant operating the remainder of the mine. Frequently pressure is brought to bear when tonnage is demanded, and the operating official will not use his best judgment in matters of this kind. The result is usually an explosion.

In preparing to unseal a fire area the operating officials have time to perfect their organization and outline a plan of procedure. This plan should be made in writing and not changed without a conference with all concerned. Sufficient

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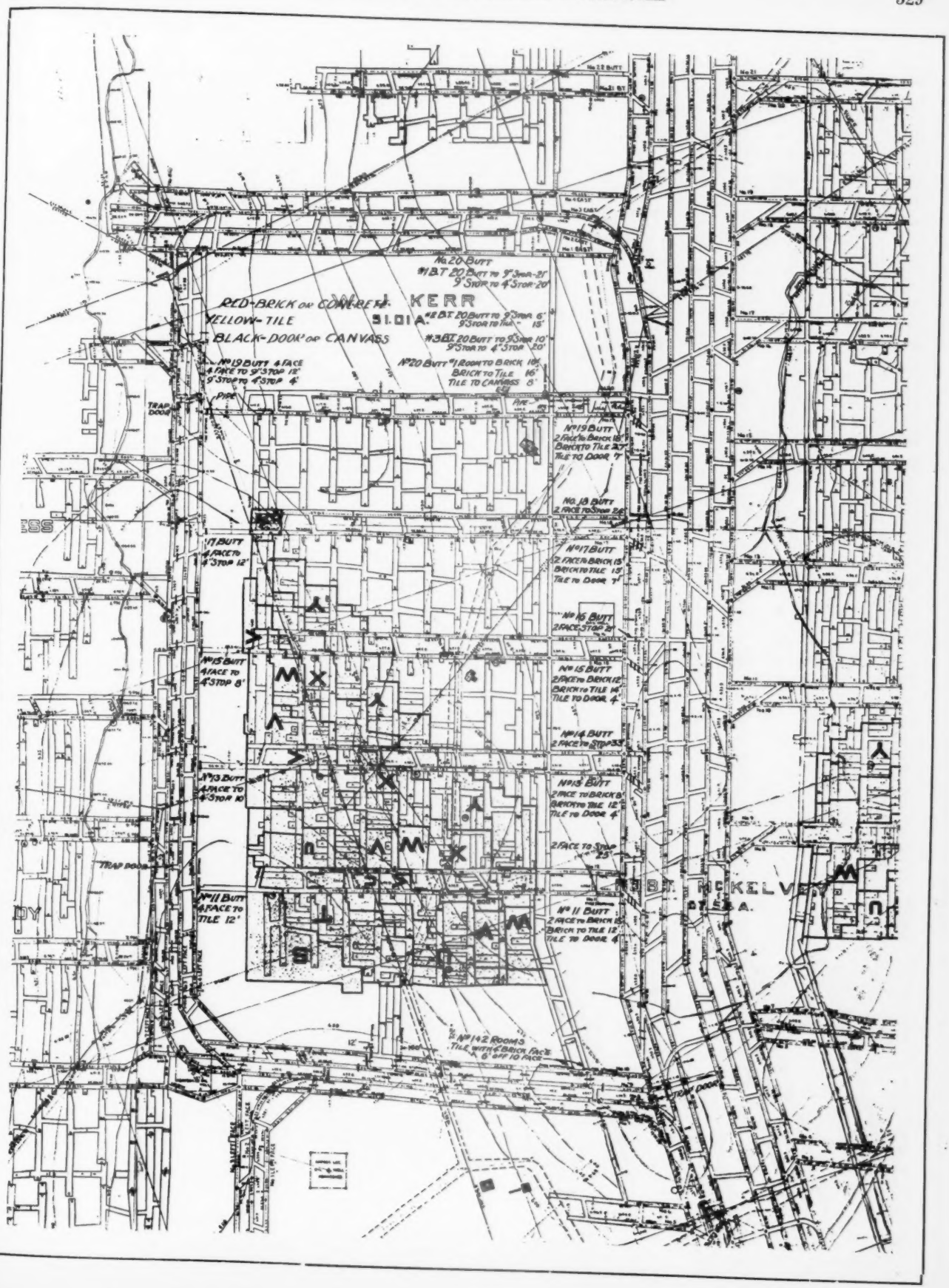

RED-BRICK OR CONCRETE
YELLOW-TILE
BLACK-DOOR OR CANVASS
No 20-BUTT
#1 BT 20 BUTT TO 9' STOR-21'
9' STOP TO 4' STOR 20'
J. KERR
#2 BT 20 BUTT TO 9' STOR 6'
9' STOR TO TOP - 15'
#3 BT 20 BUTT TO 9' STOR 10'
9' STOR TO 4' STOR 20'
No 20 BUTT #1 ROOM TO BRICK 10'
BRICK TO TILE 16'
TILE TO CANVASS 8'
No 19 BUTT 4 FACE
4 FACE TO 9' STOP 12'
9' STOP TO 4' STOP 4'
No 19 BUTT
2 FACE TO BRICK 18'
BRICK TO TILE 27'
TILE TO DOOR 7'
No 18 BUTT
2 FACE TO STOP 26'
No 17 BUTT
4 FACE TO
4' STOP 12'
No 17 BUTT
2 FACE TO BRICK 13'
BRICK TO TILE 13'
TILE TO DOOR 7'
No 16 BUTT
2 FACE STOP 21'
No 15 BUTT
4 FACE TO
4' STOP 8'
No 15 BUTT
2 FACE TO BRICK 12'
BRICK TO TILE 14'
TILE TO DOOR 4'
No 14 BUTT
2 FACE TO STOP 33'
No 13 BUTT
4 FACE TO
4' STOR 10'
No 13 BUTT
2 FACE TO BRICK 8'
BRICK TO TILE 12'
TILE TO DOOR 4'
2 FACE TO STOP 25'
No 11 BUTT
4 FACE TO
TILE 12'
No 11 BUTT
2 FACE TO BRICK 15'
BRICK TO TILE 12'
TILE TO DOOR 4'
No 14 2 ROOMS
TILE WITH 6" BRICK FACE
6' OFF 10 FACE
TRAP DOOR
PIPE

apparatus men should be provided to allow two six-man crews for underground work and two six-man crews in waiting on the outside.

All men entering the mine should be examined by a physician, and he should remain on duty during the exploration period. After the examination the apparatus men with their equipment should be turned over to an official who has charge of the apparatus and apparatus equipment for final inspection.

The exploration party should be provided with equipment consisting of all-service gas masks, approved flashlights, electric cap lamps, and CO detectors.

The printed schedule should give the names of the managers, the captain of the apparatus crew, and men on each crew, as well as the names of others who will take part in the work. The managers and officials should be so arranged on the schedule that they will not all be underground at one and the same time. I consider that one of the most essential things. A man underground knows the air in there, and no man on the outside should take the liberty to reverse the fan on him.

An official should be stationed at the pit mouth and check all men listed on the schedule and not allow any others to enter the mine. An official should have charge of the telephone at the outside air base, as well as the inside air base. An official should have charge of the fan and be especially instructed not to reverse the fan under any circumstances without personal instructions from the officials in charge of the underground work at the time of the exploration.

An official should have charge of all material and of the pumpers and pipe men. After all men have been accounted for at the outside air base, and material properly checked in, the official in charge of the electrical equipment should see that the power is cut off the mine and that switches are locked. The party will proceed to the inside air base. They will enter the air lock and break the seal in the permanent stopping. They should know beyond the question of a doubt that the oxygen is below 3 percent and that no carbon monoxide is present. An official should be stationed, with an all-service gas mask, at the entrance to the unbroken seal and use the CO detector continually while the apparatus crew is making its first examination. To quality Captain Steidle's statement, I want to say that in unsealing fires, we put an official at the opening of the air-lock area, who has charge of the life line, and although the CO coming through is not enough to put out his flame lamp it will make him sick, and he will be overcome in a short time. He can use to advantage the all-service gas mask at that particular point.

This official should also have control of the life line, as his CO detector may show that fire exists, and he will be able to signal to the apparatus crew to return.

A fire occurred at the Oakmont Mine on the night of January 13, and was discovered about 3 o'clock in the morning of January 14. Temporary seals were completed by 10 o'clock the same morning. Permaent seals were erected within the next 24 hours. The analyses and temperature readings taken from this mine have been given in Mr. Forbes' paper.

We opened the seals on April 4 and attempted to examine the area. At that time the oxygen content was about 5 percent and carbon monoxide about 1 percent. The apparatus crew made one trip of 10 minutes' duration, and before they had gone 200 feet on their second trip the CO detector indicated fire, and the crew was brought back and stated that they encountered smoke. The area was immediately sealed.

The area affected was between a six-entry system on the right and a three-entry system on the left, lying between two intake zones, with the natural return going back the right-hand entry of the three-entry system. You will note from the map that seals were placed at the entrance to the butt entries surrounding the fire area. A small current of air was taken down the original return airway to allow the inspector to examine the seals in safety. We knew that we were getting a leak somewhere and very little breathing took place, the pressure being constant on the intake side of the sealed area. We placed a number of new seals, but were not able to reduce the oxygen content. However, the carbon monoxide reduced to about 0.4, and, strange to say, the oxygen increased.

Mr. George McCaa and I examined the seals a number of times in the area affected. Some time during the forepart of June we were standing where the return air from the area affected was directed by an overcast into the main return, and Mr. McCaa suggested that we put a stopping there to prevent the suction pressure on the return side of the sealed area. We discussed this matter for some time, and finally decided that it was the proper thing to do. Samples were taken the next day, and from the analyses we were firmly convinced that our trouble was due to air pressure, as the analyses gave about 6 percent of oxygen and 0.03 percent carbon monoxide. Another sample taken on June 22 showed oxygen at 7.7 percent and carbon monoxide zero. From that time on the oxygen reduced to about 0.4 and the carbon monoxide remained at zero.

We unsealed the fire on October 19, the analyses at that time showing one-half of 1 percent of oxygen and no trace of carbon monoxide. From our experience covering this work it is evident that no attempt should be made to open a fire when the analyses show 4 or 5 percent oxygen and even a trace of carbon monoxide.

I believe it is an unsafe practice to admit fresh air to a fire zone prior to a complete examination. If it is impossible to make the examination with apparatus men without endangering their lives, I would prefer to move up the air base step by step. You will recall the conditions mentioned in the examination of the Oakmont fire in April, with oxygen less than 6 percent and carbon monoxide about 1 percent, and that this fire built up very rapidly and without any large amount of oxygen entering the fire zone, as air locks were used.

In selecting men for sealing or unsealing a fire, only those of experience should be considered, if possible. These men should be recruited from those who will not take unnecessary chances; men who have full confidence in the officials, as well as apparatus; men who know the all-service gas mask and where they can go with it safely; men who have confidence in the chemist who made the analyses of the air; and men who are physically able to do the work.

SAFETY APPLIANCES AND ACCESSORIES FOR MINE FIRE FIGHTING AND RECOVERY OPERATIONS

(*Continued from page* 527)

From the chamber a tube leads direct to a face mask containing an exhalation valve.

The fundamental principle of the H-H Inhalator is that its operation is governed entirely by the respiratory action of the patient; consequently, it can be used in connection with a manual method of artificial respiration. When the patient commences to breath, the carbon dioxide is effective and stimulates the respiratory action, so that the number and depth of the respirations increase and the patient continues to require more volume of the mixture. The limit of this increase is determined by the operator by setting the feed valve to regulate the volume which, in his judgment, the patient should receive. If this volume is set at 15 quarts per minute, the patient's respiration is quickly stimulated by the carbon dioxide that he is taking; but when he attempts to get beyond this volume the reserve breathing bag is depleted because of the fact that the feed valve is not supplying his requirements. As soon as this reserve supply in the breathing bag is partly depleted, a valve automatically opens and draws in outside air, which gives the patient the required volume he demands. But this outside air lowers the carbon dioxide content, which decreases the stimulating effect on the lungs, and in turn decreases the respiratory volume. When the volume required by the patient drops below that being supplied by the valve, the reserve bag fills up again, which closes the emergency valve to the outside and the carbon dioxide content increases to 5 percent, thus increasing the stimulating effect on the lungs. This balance can be automatically kept at whatever volume the feed valve is set to flow.

Conclusion

General methods of fire fighting, guarding against explosions and prosecuting recovery work have been resolved into rather systematic procedures. Mine gases may no longer be considered as "inherent" dangers in this work if nature's laws in respect to these gases are understood and complied with. The various appliances discussed in this paper apply directly to mine fire fighting and recovery operations, and if used intelligently will do much to eliminate explosions and asphyxiation.

Two large coal companies have been experimenting with the use of goggles during 1926. One reports a reduction of 34 percent in eye accidents, the other 57½ percent for the entire year. The goggles are furnished free, no charge being made unless the miner has lost them, when he is charged for replacement. All employes are requested to wear them only when engaged at work, such as using their picks, etc., where there is hazard to the eyes. No force or penalty was used during this period to require their use. The goggles consist of a thin light wire mesh that affords protection to the eye and are not burdensome.

HANDLING GASES THROUGH PROPER VENTILATION *

Asphyxiation The Prime Danger—Mechanical Ventilation Recommended For All Mines—35 Rules For Safety In Ventilation—Basic Problem Is to Prevent Methane Accumulation Augmented By Uniform Safety Practice

By D. HARRINGTON †

A LITERAL reading of the subject assigned me would require me to consider all kinds and classes of mines, noncoal as well as coal. Coal mines, however, will receive major consideration here, and even then I can cover this subject but partly in a short paper. Moreover, the term "gases," as used in coal mining, would include not only methane but some of the higher hydrocarbons, such as ethane, propane, and possibly other heavier gases belonging to the methane series, besides nitrogen, carbon dioxide and hydrogen sulphide. These gases are encountered in the ordinary working of coal mines, but carbon monoxide and possibly numerous mixtures of carbon monoxide, carbon dioxide, methane and nitrogen may become important at and after mine fires and explosions. Here I shall give particular attention to methane as being the most dangerous and the most abundant of the gases that make trouble in the ordinary operation of coal mines.

The danger from mine gases other than methane is chiefly from asphyxiation caused by breathing mine air in which oxygen has been displaced by nitrogen, carbon dioxide, or occasionally methane; or to a lesser degree from poisoning by breathing air containing comparatively minute percentages of carbon monoxide, hydrogen sulphide, or sulphur dioxide. It is somewhat difficult to estimate how many fatalities in our coal mines have been caused by asphyxiation. If conditions that accompany or follow mine fires or mine explosions are excluded, it is safe to say that during the past 20 years there have not been as many as 200 fatalities from asphyxiation (probably not as many as 100) in the coal mines of the United States. On the other hand, if those conditions are included, the number of fatalities from the breathing of noxious atmospheres in the mines of the United States will easily total 1,000 and may run as high as 2,500.

During the past 20 years explosions and fires in our coal mines have killed over 7,500 persons, and in at least 75 percent of these disasters methane has been the initiating element, so it is probable that during these 20 years methane ignitions have directly or indirectly cost the lives of but little less than 6,000 men. In 1926, 29 serious explosions in mines in 13 states caused approximately 380 deaths; of these explosions about 25 were initiated by the ignition of methane, and the total fatalities they caused were about 340. In few of these disasters was methane by itself the cause of all the fatalities. An explosion initiated by methane, however, gets a maximum "kick" which makes it practically a certainty that if any inflammable dust is where it can be ignited the start given by the methane will involve the dust. The latter may propagate the flame throughout the mine and thus cause the sudden death of scores of underground workers.

Methane either is actually found or may be found at any time in all classes of underground coal mines, from lowest grade lignite to highest grade anthracite. This practically universal occurrence, or probability of ocurrence, of methane, the ease with which methane ignites, and the likelihood of an explosion following ignition combine to give to ventilation its preeminent importance in coal mining.

Having made these generalizations, I will devote the remainder of this paper to numbered conclusions and recommendations regarding my conception of safe methods of handling gases in mines.

(1) Every coal mine, large or small, should have mechanical ventilation induced by a fan on the surface. The fan should be of sufficient capacity to give the workings an ample supply of air; it should be in fireproof housing and so arranged that the direction of air currents can be reversed with essentially no delay; and the arrangement for reversing should be tested out at least once a year. The fan should not be in front of the mine opening, but should be offset so that an explosion will not damage it. Preferably the fan should have two sources of power; and at very gassy mines it is preferable to have two fan units, one driven by one source of power, the other by a different power. The power line to the fan should be independent of the power lines that enter the mine. At very gassy mines (those in which the return air from any split runs as high as one-half of 1 percent methane) there should preferably be some automatic method of cutting off electric power to the mine when the fan slows down or ceases to run. The fan should have a recording water gage and should either be constantly attended or should have some automatic alarm to indicate any interruption or interference with the normal flow of air. In general, the water gage should be less than 5 inches.

(2) No ventilating fan of any description should be allowed underground in any coal mine.

(3) Every mine should be so ventilated that no face or other unsealed place has at any time over 1 percent of methane, or approximately 1 percent of carbon dioxide, or less than 19 percent oxygen; no circulating current in a split return or main return should have over one-half percent methane or one-half percent carbon dioxide. Air with carbon dioxide around 1 percent, or oxygen around 19 percent, would not be harmful physiologically yet would be indicative of sluggish or defective air circulation.

(4) Velocity of the air current in any air course should not exceed 1,500 linear ft. per minute; preferably the velocity should be held below 1,000 linear ft. per minute.

(5) No main air course, whether shaft, slope, or drift, should act as both intake and return; and no one underground opening longer than 200 ft. should be allowed to act as both intake and return if more than five persons are dependent upon that one opening for ventilation or exit. The driving of single entries of length greater than 200 feet should not be allowed in any coal mine.

(6) The main return should not be on the main haulage, especially if the main haulage road must be used to handle men.

(7) Trolley locomotives or other types of open electrical haulage or other electrical equipment should not be allowed in return air; nor should trolley locomotives run past open rooms or pillar workings which give off methane, or past sealed areas known to contain large quantities of explosive gas, nor should they operate any nearer than 500 ft. to any advancing face known to give off methane.

(8) Crosscuts between entries, other than the last crosscut nearest the face, should be closed by tight fireproof stoppings, and under no circumstances should dirt, gob, wood or brattice cloth be used for this purpose unless efficiently backed by concrete, plaster or other material which will render the stoppings strong, tight, and fire resistant.

(9) Mines should be kept divided into sections or panels in such manner that each section can be ventilated by a separate split, and in case of fire or explosion the return from each section will go to the main return without vitiating the atmosphere of adjacent sections. Moreover, the entrance to every opening to each such section should have a fire-resistant door, so that in case of fire within a section the closing of a few doors will isolate the region.

(10) Air courses should have sufficient area to allow the flow of sufficient air to keep methane as well as carbon dioxide below one-half of 1 percent and yet not necessitate velocities in excess of 1,500 ft. per minute, or a water gage over a maximum of 5 in.

(11) Main air courses should at all times be kept clear of falls; abrupt turns (either vertical, as to overcast walls, or horizontal, as in mine intersections at angles of 90° or more) should be avoided; water should not be allowed to partly close the passageways; and walls, floor and roof should be kept as nearly smooth as possible and as free as feasible of obstructions, such as center posts, cribs, gob walls, etc., which cause deflection or eddying of currents. In general, it would pay to maintain track in both intake and return main air courses as an aid in keeping the air courses cleaned.

(12a) When mine workings reach distances a mile or more from the fan, it is good policy, with respect to cost and efficiency, as well as of safety, to maintain air openings to the surface that are fairly close to working regions. These openings, whether shafts, slopes or drifts, relieve fan pressure, bring fresh air to the faces where it is needed, and serve as escapeways or exits at time of disaster.

* Published with the approval of the Director, U. S. Bureau of Mines.

† Chief Engineer, Safety Division, U. S. Bureau of Mines.

(12b) Cages, skips, cars or trips should not be left in air courses over night in such manner as to block or partly block air flow. This blocking of air currents is very frequently done, yet only rarely is there any real necessity for doing it.

(13) Coal mines should be planned to have a minimum number of doors, which must be used at ordinary working periods—especially doors on haulage roads. The proper function of mine doors is for use in emergencies. Where doors must be used in coal mines, both door and frame should be tight at all times and so constructed as to have the door close automatically. Preferably doors should be in pairs with an air lock between, that when one door is open the other will be closed; if there is not sufficient room for two doors with an intervening air lock, there should be a fire-resistant brattice curtain in place of a second door, this curtain to aid in holding the air to its proper course while the door is open. No latch should be allowed on the rib to hold any door open; on the other hand, every underground door should have a latch on it to insure that it will remain closed even if the direction and pressure of the air should be changed, as might be necessary in an emergency such as a fire or an explosion.

(14) All doors, door frames, overcasts, regulator stoppings and other underground ventilating structures or equipment should be fireproof or at least fire resistant. Where brattice cloths or canvas are used they should be treated to resist fire. Timber covered with gunite or with roofing or other sheet iron resists fire fairly well, but overcasts, door frames and regulators, as well as stoppings between main or other important air courses, should be of concrete or similar construction.

(15) All crosscuts in rooms except the last crosscut nearest the face should be closed by tight fire-resistant brattice or stopping; this is done in some mines but is neglected in many where methane is not particularly prevalent. Where any methane is found, line brattices should be used to a point within 15 ft. of the face to bring circulating air to the face; where methane is fairly likely to be found, the brattice man should leave about 15 to 20 ft. of brattice cloth at the end of the line brattice in order that the face worker can readily use the extra brattice cloth to keep air at the face as it advances.

(16) All parts of mines which are worked out or are temporarily or permanently abandoned should be sealed with strong, tight fireproof stoppings, unless such places must be held open for travel, ventilation, or other useful purpose of operation or safety.

(17) Stables, transformers, or other electrical stations, and similar places where men are likely to congregate or flammable material is likely to be in use should preferably be on a small separate air split, or, at any rate, should be so arranged as to be readily isolated by doors, or a similar method, in event of fire.

(18) It is decidedly poor practice to ventilate one mine through another or even to connect two mines; this is particularly true if one or both mines give off methane. There is grave doubt in my mind as to the advisability of allowing as many as 500 men underground at any time in any one mine. Where large numbers of men are employed underground, there should be approximately one exit to the surface for every 150 or 200 men underground, and these exits should at all times be maintained safe for travel.

(19) Bare electric power wires or open types of electric motors or switches or other electrical equipment which arcs or sparks should not be allowed in return air in which any methane is present or in regions where there is much fine, dry flammable coal dust.

(20) Mines in which coal has a definite pitch (say, anything over 2 degrees) should so arrange ventilation that intake air is taken to low points and then coursed to the rise; in other words, ascensional ventilation should be used wherever possible.

(21) In mines where the coal pitches or dips, advancing workings should be, as far as feasible, confined to the dip or to approximately this level. While it is cheaper to drive the crosscuts between level entries to the rise or to drive pitch entries to the rise, the savings thus effected through ease of handling coal and water are very frequently more than overbalanced by the difficulty of ventilating. On the other hand, dip workings are readily kept free of methane, though they are liable to cause trouble if carbon dioxide is present.

(22) Ventilation should be under the direct supervision of some one person who preferably should not be the mine foreman, for the many other duties of the foreman do not allow him to give ventilation the amount of time and attention it deserves and needs.

(23) Every mine should be given the preshift examination by fire bosses; they should have sufficient time to do all of their work in not to exceed three hours, and yet be able to spend at least five minutes at every place or face where men work. They should not have so much territory to cover that they have to travel faster than a fairly brisk walk, and should not examine any working face more than three hours before the workers enter the mine.

(24) No fire boss or other mine official should *ever* carry into a coal mine a match or an open light of any description; this applies not only to the preshift examination by the fire boss but also to the work any mine official may do in the mine during the working shift or at any other time. Bosses should be provided with permissible magnetically locked flame safety lamp and some form of permissible electric lamp. Preferably, the Burrell Methane Detector rather than the flame safety lamp should be used by mine officials in examining for methane while the working shift is in the mine.

(25) Fire bosses should not be expected or permitted to do manual labor, as there is no coal mine in which there isn't more than enough supervision or inspection to keep its fire bosses decidedly busy whenever they are in the mine. Moreover, the fire bosses should be kept familiar with operating conditions in order that they will at all times be eligible for selection as foreman or assistant foreman when vacancies occur.

(26) Flame safety lamps should not be entrusted to any person who hasn't been given by the state a certificate of competency as to his knowledge of the flame safety lamp and his ability to use it with safety and efficiency.

(27) No person should be allowed to use the long flame method of testing for gas with a flame safety lamp; the method is unsafe and inaccurate.

(28) No person should be allowed to use a flame safety lamp in a mine unless he has a certificate from a competent eye specialist that his eyesight is such that he can readily detect a gas cap on a flame safety lamp. Also, all users of flame safety lamps should be required to have their eyes tested at least once annually.

(29) Mine officials—including shot firers, fire bosses, foremen, and superintendents—should preferably be technically trained and should be required to have a certificate of competency from the state. This certificate should expire at least once every five years and should not be renewed unless the applicant passes a rigid examination indicating that he is physically able to do his work and has kept himself informed as to up-to-date requirements of the state law, company regulations and sane practices in mine safety. The applicant should in particular be required to show familiarity with the dangers from gas, dust, explosives, haulage, equipment, electricity, and falls of coal and roof, and to suggest safe and efficient methods of avoiding or overcoming these dangers. He should also be required to have a knowledge of safe procedure at the time of mine fires or explosions and should show familiarity with such instruments as the anemometer, barometer, psychometer, flame safety lamp, Burrell Detector, Orsatt apparatus, etc. These requirements seem drastic, but far too many disasters and accidents are due to the lack of knowledge and the inefficiency of mine officials. The abnormally high accident rate of our coal mines will not be materially reduced until matters relating to safety are given more intelligent supervision.

(30) Mine officials (shot firers, fire bosses, foremen, superintendents) should become familiar with the sampling and analyzing of mine air, and every mine should do its own air sampling and analyzing at sufficiently frequent intervals to give a definite idea of the exact methane, carbon dioxide and oxygen content of all splits, main returns and open accessible unventilated places. Sampling of all returns should be done at least once a month, and measures should then be taken to hold the methane content of any return to less than one-half of 1 percent.

(31) Whenever an open fire occurs in a mine the working shift should be withdrawn as soon as possible and not allowed to return until the fire has been extinguished or sealed.

(32) Whenever the main fan stops or is "slowed down," underground workers of all kinds should be withdrawn; they should not be allowed to return until fan operation has been resumed and all accessible open places have been given a thorough examination and are known to be free of gas.

(33) Fire bosses should make a signed statement on a report as to mine conditions before the working shift is allowed to enter any coal mine. The written record should state the size of "cap" wherever any explosive gas is found, give an estimate of the number of cubic feet present, and designate with fair accuracy the place where the gas is found. No workers should be allowed to enter any place where an explosive mixture is present.

(34) If an accumulation of as much as 100 cu. ft. (*Continued on page* 534)

HANDLING GASES THROUGH PROPER VENTILATION

Evolution Of Ventilation Traced—All Electrical Installations Confined To Intakes—Exhaust Steam From Fan Discharged Into Intakes—Two Inspections Of Working Places Per Shift By Fire Bosses—Only Officials And Repair Men Permitted In Return Airways

By ROBERT MCALLISTER *

COAL mine ventilation has progressed from the crude methods adopted to furnish sufficient air at the working face to keep a miner alive, to a real science where air at the face is as pure as air in many of our congested streets with the menace of the automobile exhaust presenting a serious situation.

We can follow ventilation through the course of obsolete methods; natural heat with the upcast shaft higher than the intake and giving fairly good results under the proper atmospheric condition, changing with the temperature of the weather to neutral, and finally a reversed direction of the intake air. Artificial heat by means of the mine furnace has been employed by the small operator as a ventilating agency in the absence of firedamp with success up to the time of disaster, which usually occurs as a reward for the continuance of this practice.

Ventilation by mechanical agencies has become a recognized factor as a means for safety to the miner at the working face, several states have passed coal mining laws restricting ventilation of coal mines to a positive mechanical means, and the centrifugal fan is, without exception, the common mechanical agency for coal mining ventilation. Booster fans are employed with remarkable success, and the auxiliary blower when used with flexible canvas tubing has proven satisfactory as a means for ventilating single entries to a distance of 1,000 ft., but the gaseous mine is a renegade and the only relief is to lay out the mine to fit the ventilation, not the ventilation to fit the mine.

The United States Bureau of Mines believes that all coal mines are potentially gassy:

Class 1 Coal Mine—A practically nongassy mine in which flammable gas in excess of 0.05 percent can not be found by systematic search.

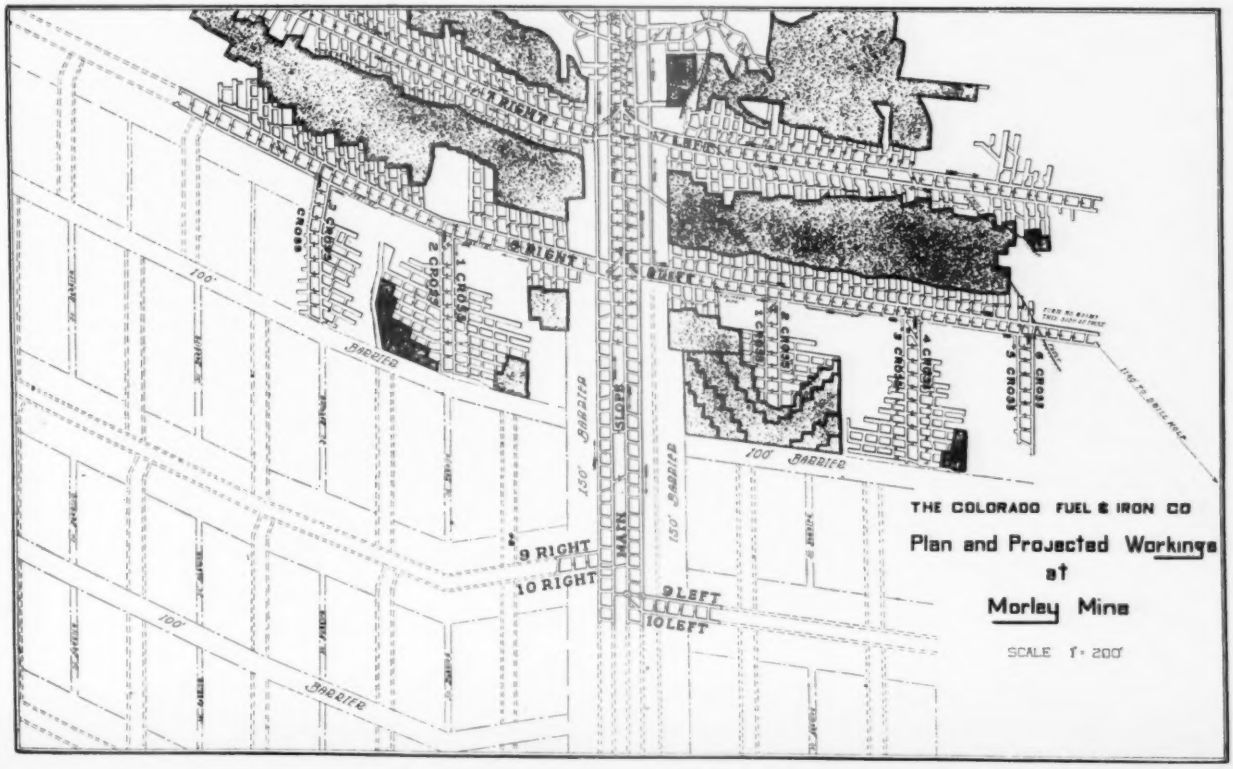
Class 2 Coal Mine—A slightly gassy mine in which flammable gas has been found, but in less than 2 percent in still air in any active or unsealed abandoned workings; or flammable gas can be found, but in quantity less than 4 percent, in some place from which the ventilating current has been shut off for a period of one hour; or flammable gas can be found, but in quantity less than one-fourth percent in a split of the ventilating current; or flammable gas is found in quantity greater than the specified rate of not more than 25 cu. ft. per minute.

Class 3 Coal Mine—A gassy mine in which flammable gas is found in quantity greater than specified for a Class 2 coal mine. Percent of flammable gas must be determined by sampling, analysis and ventilating current measurement

Morley mine is one of the 30 coal mines operated by the Colorado Fuel & Iron Co. and is a gassy mine, Class 3. All of the coal mines in the district at the time Morley started to develop, employed the two-entry system, and continuous circulation by means of doors and curtains in the usual manner, with an occasional overcast and split. This system was found extremely dangerous as the mine started to work off the 4th right and 4th left cross entries. An increase in the quantity of the air on the intake did not give the degree of safety desired, and miners working on the end of the air were exposed to a constant cap in their safety lamps, which at times would reach a height equivalent to 2 percent methane.

Three-entry system was not common in the west at this time, and Morley mine was the first to adopt this means for a positive distribution of the air with an isolated main return to the fan. Each pair of cross entries on the two sides of the slope received air from a regulated split and delivered by means of overcasts to the main return.

As the mine progressed with development, the splits became more numerous, and a demand for more air became apparent. A larger fan was installed, a fourth entry was driven to complete two intakes and two return air courses. Again, a larger fan was installed and a fifth air course was completed, three intakes and two returns, along with a new system of making the mine fit the ven-



* Chief Inspector, The Colorado Fuel & Iron Co.

tilation instead of a never ending attempt to make the ventilation fit the mine.

On account of the gaseous condition, the use of electrical appliances for underground haulage is limited to installations on the main intakes; coal cutting, mechanical loading or electric lines for any purpose are not permitted on any return air course. All coal is mined and picked down by hand without the assistance of powder. Haulage from all of the rooms and practically all of the gathering partings is done with mules.

During the past two years the concentrated system has been in effect, a method to make the mine fit the ventilation and insure a rapid diffusion of the methane with the circulating current of air, and produce the maximum coal tonnage from room and pillar operation.

A plan of this system is in width, 1,500 ft. or the distance between pairs of cross entries, and in length the termination of the cross entries at the boundary of the property, several thousant feet in extent. A 150-ft. barrier pillar is provided to protect the main entries off of which the cross entries are driven. Two pair of panel entries are driven at right angles off the pair off cross entries, one pair of panel entries to each cross entry, at a distance of 300 ft. from the 150-ft. main entry pillar and extended 700 ft., which leaves a barrier pillar of 100 ft. between approaching panel entries off of cross entries 1,500 ft. apart. Rooms are started at 50 ft. centers coming back from the face off of the panel entries and driven up with a working face of 20 feet to a distance of 275 feet on the inby side or the approach of rooms off the second pair of panel entries driven 600 ft. from and parallel with the first pair of panel entries. Driving the rooms 275 ft. leaves a barrier pillar of 50 ft. between finished approaching rooms. The 30 ft. pillars are extracted shortly after the rooms have been driven up to the barrier pillar.

One of the cross entries is provided with a regulator on the inby side of an overcast to the main return which can be adjusted to a ventilating current varying between 18,000 cu. ft. and 56,000 cu. ft. as the quantity of air may demand for diffusion of the methane. The intake cross entry is used for the haulage road and gathering partings for all of the rooms extended off of panel entries driven to the right and to the left off of the cross entries. Each pair of panel entries is ventilated by a secondary split; all panel return entries deliver to the cross entry return by direct delivery or through overcasts. Briefly, each working area of 550 ft. by 700 ft. off of two panel entries has a ventilating system independent of a neighboring panel section with an adjustable quantity of air by means of a regulator.

There are three stages to the operation of panels off of any pair of cross entries. *First*, the development of cross entry extension and driving of panel entries to the boundary pillars. *Second*, the development of room necks, extension of rooms and partial extraction of pillars. *Third*, the final extraction of remaining pillars and a provision for a return of the gases made in the worked out area to the return air courses.

This system for mining and ventilation reduces the mining area to less than one-half as compared with the former practice and gives a positive fresh air circulating current to every working face.

Room crosscuts are driven as often as the inspector may order, but under no circumstances shall the working face be more than 60 ft. in advance of the air current. The air in every room is taken to the face with a line brattice from the last crosscut. Entry driving has the same provision, and every man at the working face has instructions to cease work and retire to the fresh air when the velocity of air at the face is reduced by a leak in the line brattice by a fall of rock or otherwise.

A most careful supervision is maintained of the ventilating system by the mine foreman, assistant mine foreman and fire bosses during the time the men are engaged. Gas samples are taken from each of the cross entry returns, slope returns, and main return at the fan. At present samples from the main return at the fan show by analyses 0.6 percent methane—speed of fan 378, water gauge 7.8-in., quantity in return 220,320 cu. ft. per minute, methane per 24 hours 1,903,564 cu. ft.

The mine is provided with two Sirocco fans, 8 ft. by 3 ft. 8 in., driven with rope transmission off 410 H. P. Chuse engines, at a fan speed of 378 R. P. M., running independent of each other with a 7.8-in. water gauge and delivering separately 225,000 cu. ft. of air per minute on the exhaust. A mercury device actuated by the mine pressure is installed at each fan and so constructed as to cause a steam whistle to sound an alarm when the water gauge begins to drop and give the engineer time to start the dual fan before any effect is made on the mine ventilation.

Exhaust steam from the fan is allowed to discharge into two intakes, more particularly the slope haulage, a double track entry 22 ft. wide by 7 ft. in height, as a means of humidification assisted with steam coils to heat the intake air and water sprays every 50 ft. Additional humidification is accomplished with sprinkling lines installed the length of all intake entries, main, cross and panel. The mine shows not less than 96 percent relative humidity at any working face, and all of the returns have a dew point or saturation. It is important to keep the old workings and returns in a humid condition to avoid any possible chance for ignition of an explosive fire damp mixture by fall of rock.

Edison improved electric safety lamps are used by the miners. Fire bosses search the men every morning for matches outside the mine as a reminder; the men are again searched underground at the fire bosses station. A penalty of 90 days in jail is assessed when found guilty of having matches in their possession.

Every working place in the mine is examined by the fire bosses during the early morning hours; no miner is permitted to enter until the mine is reported clear of gas. The fire bosses make a second trip around the mine while the men are at work as assistants to the mine foreman. A fire boss's certificate must be obtained from the chief coal mine inspector by examination and experience in gaseous mines before a permit is granted to carry a safety lamp in this mine.

The system of holding the working areas with boundary pillars has proven satisfactory. The ventilating current is under control for almost any emergency, there are no leaks on the intake side of the ventilating system, and the returns are isolated from the working force as a whole. Mine officials and repair men are the only persons permitted to enter a return air course under the penalty of discharge.

HANDLING GASES THROUGH PROPER VENTILATION
(Harrington)

(*Continued from page* 532)

of an explosive mixture of methane and air is found which can not be removed from the mine before the working shift enters the mine, the place should not be worked nor should any work be done on the return side of the place and the region should be guarded against intruders. Under no circumstances should as much as 100 cu. ft. of an explosive mixture of methane and air be moved while the working shift is in the mine.

(35) Accumulations of 100 or more cu. ft. of an explosive mixture of methane and air should be moved only when all persons are out of the mine, except those actually and actively engaged in the moving of the gas, and, if possible, all electrical current should be shut out of the mine while accumulations of gas are being moved. Use of wafting methods, sprinkling with water spray, or similar means of artifically mixing methane accumulations with surrounding air is dangerous, ineffective and often disastrous. Methane accumulations should be moved only by bringing active circulating air currents to the place of accumulation; the purpose is not only to remove the accumulation but to insure that there will not be another accumulation at the same place in a short time. No persons should be allowed to move methane or to assist in moving it except men of more than average intelligence, acting under the supervision of the mine foreman, fire boss, or other person or persons holding a certificate of competency by the state.

Conclusion

A short paper like this can cover only a few of the factors that enter into the handling of gas or gases by ventilation. Moreover, as the manifestly proper method of handling methane *safely* is to prevent it from accumulating in dangerous proportions or quantities, the paper has been confined largely to suggestions that relate directly or indirectly to the prevention of accumulations. Although some of the suggestions are unusual, and by many persons will be considered drastic, we must remember that the statistical record shows that methane ignitions of various kinds in our coal mines have caused about 300 deaths annually for the past 20 years, and that the record of 1926 was about 340. Our present-day progress seems backward rather than forward, and if we are to achieve a real advance we must alter our ways and alter them decidedly. Moreover, since it will take time to correct existing defects in coal-mine ventilation, we will do well to adopt other precautionary measures, such as the universal use of closed lights, permissible explosives, rock-dusting, permissible electrical equipment, and of watering methods at the faces. At the same time we should "get busy" in improving the ventilation of our coal mines until their safety and efficiency approach what the American public has a right to expect.

UNDER WHAT CONDITIONS SHOULD TOP CUTTERS BE USED

Top Cutting Lessens Shattering Of Roof By Blasting—Possibility Of Making Cut In Parting Or Soft Top—Coal Roof Effective In Advance Work But Retards Pillar Work—Advantages And Disadvantages Summarized

By T. W. GUY *

TOP cutting should be carefully considered whenever there is bad roof or troublesome impurities at or near the top of a coal bed. Before the day of top cutting machines it had long been the practice in a great many coal mines working thick seams to leave a coal roof to protect or support the overlying strata and to prevent impurities lying above the coal from becoming mixed with it in mining. In some cases, it was comparatively easy to leave a good coal roof while in others it was difficult or impossible because there was no parting or other natural cleavage plane at or near the desired point. Top cutting machines were developed about 15 years ago which made it possible to leave the most economic and effective thickness of coal for roof support. This largely increased the number of mines which could benefit from coal roof, and it also made it possible to avoid the effect of blasting against the roof.

Many mines have found it profitable to cut out bands of impurities in the seam, making in some cases vital improvement in cleanliness and preparation of their product. Others have found it profitable to cut out soft draw slate above the coal where the roof overlying the draw slate is good. Where practicable, this method, it is said, removes the slate at somewhat less cost and has the addtional advantage that it makes rock dust instead of coal dust at the face and should yield cleaner coal with a larger percentage of lump.

Of course the possibility of reducing cost by top cutting in any mine depends primarily on the local mining conditions. When considering a coal roof, we must have sufficient thickness of seam to give the necessary head room under the coal roof which, in itself, must be strong enough to support its own weight and the overlying strata for several years. This can only be determined by experiment.

In Logan County, West Virginia, the Chilton bed, which is worked by the Boone County Coal Corporation, has at the top from 3 to 4 inches of bone and rash, and above this a heavy draw slate varying from 18 to 54 inches in thickness. In entries, rooms and pillars, this comes down, or has to be taken with each cut unless coal roof is left to support it. In one mine where the draw slate runs from 36 to 54 inches, top cutting with the Arcwall mining machine was begun in 1913, leaving from 6 to 10 inches of top coal which supported the roof very effectively. Since that time, the main entries have advanced about 10,000 feet. In 1921 the coal roof and slate was taken down on the main entry for a distance of 1,600 feet from the outside and an additional 1,300 feet was taken down this year. Over the remaining 7,000 feet driven from 1915 to 1927, the coal roof is still standing satisfactorily except for a few local falls aggregating less than 6 percent. With top cutting this mine has been operated steadily, losing less than 10 days per year on account of "no market." To operate without top cutting would require handling more slate than coal and probably increase the cost from 60 to 75 percent.

Another mine where the slate runs from 20 to 24 inches thick was opened in 1916 and reached an output of 400 tons per day. One Arcwall machine was started in 1919, leaving 6 to 8 inches roof coal and taking out an average of 66 inches of coal. Additional top cutters were added until 1924, when the territory on top cutting was producing an average of about 1,600 tons per day and the Shortwall territory still about 400 tons per day. At this time the Shortwall machines were taken out altogether. It was then found that top cutting, and the elimination to a large extent of slate handling by leaving coal roof, reduced the average labor and supply cost approximately 20 percent, and on account of increased output, reduced the overhead per ton on somewhat greater ratio.

In this mine the coal roof was not quite as effective as in the one mentioned above, the coal falls averaging from 10 to 15 percent as the places advanced. As an average, however, the roof remains good from 3 to 5 years. The coal roof does not support the draw slate as effectively in pillar drawing as in first mining. A very slight amount of weight or settlement on the pillars causes the coal roof to break letting down the draw slate. The resulting condition then makes it more difficult to keep men on the pillar work because they have to handle slate, and it is also more difficult to load clean coal. All of these factors have the effect of retarding the pillar work, which in turn makes the roof troubles more serious. In spite of these difficulties, however, it has been possible to cut more than 90 percent of the pillars by machine. In the mine with 36 to 54 inches draw slate, the coal roof was much more effective as a roof support, and the average efficiency in this mine in the pillar work was only slightly less than in the rooms.

In another mine, where the total thickness of the coal was about 62 inches, the Arcwall was tried, leaving about 2 to 3 inches of coal under the bone which always lies at the top of this seam. This supported the roof for a short time, but on the whole, did not prove effective, and after about 2 years experimenting, the top cutting was abandoned.

The following is a summary of the advantages and the disadvantages of top cutting as developed in the Boone County Coal Corporation mines:

ADVANTAGES

(1) Fewer accidents from roof falls.

(2) Decreases cost of cutting approximately 40 percent compared with Shortwall.

(3) Cleaner coal produced.

(4) Eliminates action of explosive against roof in shooting coal.

(5) Fewer interruptions due to slate falls.

(6) Permits more rapid development.

(7) Increased output per man and unit of equipment; consequently, increased output from the mine with lower cost.

DISADVANTAGES

(1) Requires more explosives to shoot the coal. Auger holes collect water, making it necessary to use permissible explosives.

(2) Increases coal dust.

(3) The places are wider at the top than at the bottom; consequently have a greater roof span in proportion to the effective width of the place.

(4) The ribs sloping inward form shelves for the accumulation of coal dust. These shelves, however, become an advantage when rock dust is used.

(5) There is also a greater fire hazard with coal roof.

(6) With the top cutting we get less lump coal, particularly due to the fact that more explosives are required to shoot the coal upward than would be required to break it down for loading if it were undercut.

(7) We also get less lump due to the fact that the Arcwall machines make a crescent shaped cut, the points of which are long and sharp in a wide room with the result that the coal can not be shot as efficiently as if it were in a rectangular body as it would be if undercut with a Shortwall machine.

In these two mines it is estimated that the Arcwall machines give from 3 to 5 percent less lump than would be obtained by undercutting with the Shortwall.

(8) It was also found more difficult to adapt mechanical loading or conveyor systems without losing the advantage of the coal roof which means slate handling.

(9) The coal left to support the roof is lost, but the resulting saving in operating costs amply justifies its sacrifice.

* General Superintendent, Boone County Coal Corp., Sharpless, W. Va.

CRUDE PLATINUM IN 1926

THE total production of crude platinum in the United States in 1926 was 286 ounces, according to reports from mine operators compiled by James M. Hill, of the Bureau of Mines. This output is more by 115 ounces than the purchases by refiners reported in a statement on platinum and allied metals in 1926 by the Bureau of Mines.

Mine operators in California in 1926 produced 269 ounces, valued at $22,610, as compared with 312 ounces, valued at $36,000, in 1925. Oregon miners sold 7 ounces of crude platinum, valued at $695, in 1926 as compared with 19 ounces in 1925. Information supplied the Bureau of Mines indicates that 10 ounces of crude platinum was produced on Dime Creek, Alaska, in 1926. The Boss mine, Clark County, Nevada, was not operated and no ore was produced at the Rambler mine, Albany County, Wyoming, in 1926.

APPLICATION OF TOP AND BOTTOM CUTTING MACHINES

Development Of Top And Bottom Cutting Machines Makes Available To The Coal Operator Three Alternative Methods of Cutting—Advantages Of Each Under Particular Conditions Outlined

By WILLIAM Z. PRICE *

EACH system has its adherents and each its critics but let us analyze them by the application rather than by pros and cons.

First. The over or top cutting machines. These have four distinct advantages:

(1) Removal of bands of impurities in the seam at varying heights.

(2) Establishing more permanent roof.

(3) Increased tonnage over bottom cutting.

(4) Decreased cutting cost.

There are two distinct designs on the market and each undoubtedly has its advantages. Each section of the country has its own peculiar conditions that might make one to be preferred over the other. Before the advent of the top cutter we had to rely on cutting at the floor for most of the machine mined coal. Now two choices are available and a third has just made its appearance. The latter I will discuss later in this paper.

It was claimed at first that more powder would be required for shooting the coal when cut at the top. This has been discounted by actual experience and I know of instances where even less explosive has been used with satisfactory results.

To operators having coal seams with a band of bony coal that is troublesome to separate, the over cutting machine is the answer. There are distinct limitations, of course. I have in mind an operator in Indiana County, Pa., who is using one of these machines to cut such a band in the Upper Freeport. This installation was made in order to produce cleaner coal. A kerf, approximately 5½-in. high, is cut and the cuttings gobbed in the room. This eliminates the bug dust formerly obtained by bottom cutting, gives a cleaner product and a higher percentage of lump coal.

In northern West Virginia and southwestern Pennsylvania the draw slate over the Pittsburgh seam presents another problem. To take this down is costly and in some instances impractical. Where the thickness of the coal permits, roof coal from 6 to 15-in. in thickness is left in place in order to reduce the cost of roof maintenance. This excludes the air from the slate and is in most cases highly successful.

Let me state one instance of the value of this roof coal. The mine in question is afflicted with a draw slate varying from 6 in. to 10 ft. in thickness. For 300 ft. along an entry that had been cut with a shortwall machine there were 54 posts and 22 crossbars. In the next 300 ft. cut by a top cutter there are 16 posts and 7 crossbars. As each crossbar requires two pos's, there were only two single posts in this interval.

There are also some mines in this same territory where numerous rolls or horsebacks occur along the floor of the Pittsburgh seam. These entailed costly cutting and low efficiency together with dirty coal. Top cutting again solved the difficulty.

In some sections of Somerset County, Pa., in the C prime seam, slips occur which extend diagonally through the coal. Shortwall machines frequently experienced serious trouble in cutting as the coal would settle on the cutter bar before the cut was complete. Since top cutters were introduced this is no longer a problem.

Another tremendous advantage is in the handling of the cuttings. When cutting at the top of the seam, the cuttings fall to the floor thus keeping the cutter bar clean. There is no donger of it being carried back in the cut and the efficiency of the blasting diminished.

Now top cutting is not a cure-all. Like any method or machine it has its limits but I submit the obvious merit where these machines can be used. The fact that it never leaves the track and is of course, self-propelling enables it to cover greater territory than shortwall machines and 600 tons is not uncommon for a shift. This is where the distance between succeeding places is short but a consistent average of 500 tons has been made in a mine under development only. With these tonnages, a lower cutting rate is commonly obtained with all that it implies.

Men at the face who commonly have worked under roof that has been shattered or loosened by blasting under-cut coal welcome, almost universally the top cutting machine. I say, almost universally, for there are many who work under bad roof yet know nothing of top cutting or in seams where its application is impractical or impossible.

Bottom cutting by the ordinary method is too common and well known to require any further elaboration. I believe it is the only practical method to use where the coal is thin, where a natural hard roof is present or where ribs are to be drawn in high coal with poor roof.

The last named condition admits of some argument but with bad roof and close posting it is often impossible to allow a sufficient interval between posts and rib to permit a top cutter to slab successfully. Some mines are doing it but I am of the opinion it is at decreased efficiency.

The third choice previously referred to is the bottom cutter that remains on the track like the top cutter. I have some facts on its operation and believe the idea is sound and that it will prove to be extensively used. One mine in West Virginia reports the following figures in connection with operation of these machines:

Average hours per shift for machine	9½
Average daily tonnage	330
Average tons per place	18
Undercut ....ft.	7½
Height of seam removed....ft.	7

Recovery figures show that 96 percent of the coal is loaded out. Nine of these machines are used. The mining is done on the 100-ft. block system, the machines cutting on both advance and retreat. The only coal not cut is the last stump in each pillar. The above time includes the drilling as the machines are so equipped. The local management estimate that 20 percent more coal could be cut if the drilling were omitted.

It is a fact that the necessity for steady and powerful pumps in anthracite mines was largely instrumental in developing both pumps and stationary steam engines in this country a century ago. But the contribution made to general progress in this respect by the anthracite industry receives little notice, just as the industry's part in the development of the first really effective power fan and of the electric mine lamp has been largely ignored, according to the Anthracite Bureau of Information.

Another important development is taking place in the anthracite industry, the use of automatic electric control equipment. Fortunately this has been surveyed by an expert, C. R. Seem, electrical engineer for the Glen Alden Coal Company, and digests of his report have received some publicity in technical publications.

Mr. Seem's findings are to the effect that wherever such control is used it is found both reliable and economical. Automatic centrifugal pump control was begun in 1922 in the anthracite field, and the results have been more than satisfactory. As an instance of reliability, the case of an automatic centrifugal pump at Enterprise is cited. For several months there had been low water and this pump was out of commission. But when high water suddenly came, and this pump was visited for the purpose of starting it, the men in charge found that it had automatically primed itself and was working. There had been no inspection during the period of idleness.

At the time the survey was completed the anthracite region had 120 full automatic pumping stations, 40 semi-automatic pumping stations, 189 automatic fan installations, 30 automatic power converting stations, and 74 semi-automatic power converting stations. One of the recent installations is at the Wanamie mine of the Lehigh & Wilkes-Barre Coal Company. This is a gas engine auxiliary fan drive. When power fails on the main supply line the gas engine is set in operation and supplies auxiliary power before the fan speed falls to 70 percent of the normal.

* W. H. Warner & Co., Washington, Pa.

BLASTING PRACTICE AT THE MINES OF THE GAULEY MOUNTAIN COAL CO.

Magazines Built At Each Mine To Avoid Handling Through Store—Only Daily Requirements Issued—Individual Record Kept Of Explosives Supplied And Tonnage Recovered—Compulsory Use Of Special Bug Dust Shovels

By C. E. CARDEN *

THE mines of the Gauley Mountain Coal Co. are located in Fayette County, W. Va., the main office being at Ansted, W. Va., Mr. R. H. Morris, general manager. The Rich Creek operations of this company are located at the mouth of Rich Creek, which flows into Gauley River about 10 miles above the mouth of the river. The office is located at Jodie, W. Va., and Mr. R. F. Overly is the superintendent. These mines are served by the Gauley Branch of the Chesapeake & Ohio Ry. Co.

There are four mines at this operation and the following seams are worked: No. 1 and No. 2 mines in the No. 2 gas seam; No. 3 mine in the Big Eagle seam and the No. 4 mine in the Winifrede seam. These mines are all drift mines, non gaseous and produce at the rate of about 350 tons per day each.

In July, 1926, pellet powder was given a trial in each one of these mines with the exception of No. 2, which was down at that time. The powder used was the No. 18, 2F, cartridges 1⅜-in. in diameter by 8 in. long, 6 pellets to the stick and averaging around 75 sticks to the 50-lb. case. The results were so promising that it was decided to make a more thorough test and an order was placed for 1,500 lbs. or 30 cases. The loaders were given individual instructions on the use of this powder and the outcome was very satisfactory to both the men and the company. Accordingly it was decided to put all of the mines on pellet powder, blasting in the past having been done with both keg powder and permissible explosives.

Prior to this all explosives had been handled at and through the store. This practice was done away with and small magazines were built at each one of the mines to take care of the current supply. These magazines, of galvanized sheet iron construction, were made 6 ft. by 6 ft. by 8 ft. high with a 4-ft. extension on one end under which lights were hung to enable the distributor to see on dark days. Also small magazines were built to take care of blasting caps of which a very limited supply is kept on hand. These magazines are only about 2 ft. square, made of inch boards and lined on the outside with galvanized iron. These were placed on posts sunk in the ground and located some little distance away from the powder magazines. This eliminated the dangerous practice of keeping powder and detonators in the store. The change also kept powder and detonators out of the miners' residences, the men having been in the habit of buying powder in kegs or cases, storing at their homes and taking only enough to the mines each day to do the day's shooting.

As No. 1 mine was closed down in January on account of market conditions and the entire output from No. 3 mine was coming from pillars, the most complete records and figures were compiled at No. 4 mine. Therefore, the comments following will apply only to this mine although the general practices as to distribution, kind of explosive used, stemming, bug dust, etc., applies equally at all of the mines.

As stated above the No. 4 mine operates the Winifrede seam, which occurs high in the hills at this point and has very little cover. The coal is lowered in 6-ton monitors over a 2,000-ft. gravity plane with an average grade of 28 percent. The drum is a Stine Special No. 8 machine and Tru-Lay rope 1⅛-in. in diameter is used. The tipple is of modern wood construction, sided and roofed with galvanized iron. The machinery is of Webster make and inclined shaking screen type with loading booms for the lump and egg coal. Four sizes can be prepared, 4-in. lump, 2-in. egg, resultant nut and slack and run of mine.

The method of working is the double entry, room and pillar system. Entries are driven 12 ft. wide and rooms 35 ft. on 60-ft. centers. Pillars are drawn as the rooms are driven out. The coal is undercut with one Goodman Type 12AA Shortwall machine with a 7½-ft. cutter bar and one Sullivan Type CE7 Shortwall machine with a 6½-ft. cutter bar. The average height is 4 ft. 2 in. and an average section would be about as follows: 19 in. splint coal, 3 in. bone, 6 in. gas coal, 2 in. bone and 20 in. splint coal.

The powder distributor, whose time at this work is charged against the store, is required to be on hand at the magazine early enough to distribute the powder before work time. No labor trip is run and the explosives are carried in by the men as they go to their places. A great majority of them use reclaimed gas mask bags for this purpose which are furnished by the company at cost price. Only sufficient powder for the day's requirements is issued. Pellet powder, costing $8 per hundred pounds, is sold to the miners 3 sticks for 25 cents or 7 sticks for 50 cents. The distributor keeps a report form called "Shooting material sold to miners," which is made out each day and gives a list of the men receiving explosives, caps, squibs, etc., and the quantities of each received. This is checked over by the mine foreman and is passed along to the store department where the charges against the men are made. These reports are then turned over to the accounting department and at the end of the month they are tabulated and a report made out showing for each man the tons of coal mined, quantity of explosives used, tons mined per stick and tons mined per pound of explosives. In this way a very close check can be had on the quantity of explosives used by each man and overshooting can be checked up readily. A quantity of permissible explosives is kept on hand to meet certain conditions but none is given out except on written order from the mine foreman.

One of the tools required for each loader is a long handled bug dust shovel for cleaning out from under the coal after it has been cut. These shovels are furnished the men at cost price. Some of the men use old coal shovels which have been straightened out and rehandled with long handles. Bug dust is loaded out before shooting. Clay is used for stemming and a supply is always kept accessible to the miner. The old miner's squib is used for igniting the powder, it being decided that the chances for accident would be less than it would be should electric squibs be used, due to the fact that none of the men were familiar with this method of firing. Firing by fuse was also considered but was eliminated on account of the ever present practice of short fusing and inadequate tamping with attending inefficient blasting.

The top is composed of from 12 to 18 in. of laminated coal and shale which is badly broken and unless posted securely comes down without warning. Considerable water is encountered in the dip rooms and care must be taken in shooting to prevent the top from shattering and coming down with the coal. One and three-quarter-in. bore holes to accommodate the 1⅜-in. cartridges are started just above the upper streak of bone and landed 8 to 10 in. from the top. In the entries the holes are set about 20 in. from and parallel to the ribs, two holes being sufficient to set the coal down. Two and a half sticks to the hole is the usual charge. In rooms, two rib holes set about 12 in. from and parallel to the ribs and two middle holes is the usual practice. From 2½ to 3 sticks in the middle holes and from 2 to 2½ sticks in the rib holes are generally sufficient. The middle holes are fired first and the coal shot down is usually loaded out before the rib holes are fired, although this is not made obligatory. In rooms, immediately after the undercut has been made and before shooting, posts are set at the face, one on each side of the track to prevent the roof from springing and for safety purposes. Each hole is loaded and fired before the next hole is charged. Bone is loaded out in entries and gobbed in rooms and every effort is made to clean the coal at the face. One man on the picking table and one man on each loading boom aid in the clean coal program.

The following table gives the percentage of each grade of coal produced during the last five months, together with tons produced per stick of pellet powder and tons produced per pound of pellet powder and the average cost per ton to the miner. (*Continued on page* 540)

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BLASTING AND PREPARATION FOR MECHANICAL LOADING

Coal Friable And Without Vertical Cleavage And With Six Inch Slate Parting—Bottom Coal and Parting Snubbed Out Allowing Top Coal To Fall Loose—Lump Output Increased Eight Percent Over Hand Loading

By ROY T. LYONS *

THE mine employing the method of coal shooting and cleaning for mechanical loaders, as described in this paper, is located near Saginaw, Mich., and is owned and operated by the Consolidated Coal Company of that city.

At this mine we are mining the Saginaw Seam which varies from 3 ft. to 5 ft. in thickness, the following described operation being in coal from 4 to 5 ft. thick. The coal is rather soft and friable, has no definite vertical cleavages, or butts and faces, but there are pronounced horizontal bedding planes through the coal that assist considerably in our blasting. Our biggest obstacle to be overcome in the shooting of this coal is the presence of a hard band averaging 6 in. in thickness and lying from 12 in. to 18 in. above the bottom. The band parts readily from the top and bottom coal which facilitates the easy removal of the band, this being especially helpful in the preparation for the mechanical loaders.

Here we are using the simple system of room and pillar mining, with rooms worked 40 ft. wide and 150 ft. deep and turned on 50-ft. centers.

In hand loading, the coal requires fairly hard shooting in order to break the slate band and bring down the top coal. This results in a large reduction in the percentage of lump coal, which is an item of no small importance to us as our market is largely domestic. The hand loader uses three and sometimes four holes per shot for a 40-ft. face, all depending upon conditions that vary somewhat in different sections of the mine. These holes are drilled about 8 in. from the top, rising toward the back of the cut so that they are as close as possible to the roof at the back. The two rib holes, which are gripped slightly, are each loaded with two sticks of 40 percent dynamite and the middle hole or holes each with one or one and one-half sticks. These shots are sufficient to break the band, but shatter the coal considerably and just set the cut down on the bottom instead of rolling it out from the face. The room miner cleans and gobs the band as he loads out the cut, being paid the regular draw slate rate and which adds a fraction over 10 cents per ton to the cost of the coal.

When we decided to install the Type B Goodman Entry loader at this mine, the first obstacle to be overcome was the removal of the 6-in. band before loading out the coal. It was not practicable to load out the band along with the coal as we do not possess sufficient facilities in the tipple for cleaning that much dirt. To clean out the band while the loader was working in a place was deemed inadvisable as it meant that the operating time of the loader would be materially reduced while the face men were taking out the dirt.

Another factor that we had to consider in shooting the coal is the manner in which the scoop of the loader gets its load at the face. The most efficient operation of the loader is obtained when the coal is loose and away from the face of the cut, so that the scoop can pick up its maximum load and get away with the least delay possible. If it is necessary for the scoop to dig into the face for its load, or for the face men to pick down the coal, the operating time of the loader is thus reduced and percentage of fine coal is increased.

So, with all of these conditions confronting us and after some experimenting with different methods of blasting and removing the dirt band, we finally adopted the following practice as standard for shooting before the Entry loaders.

Three holes are drilled in the top coal immediately above the band, there being one hole about 18 in. from each rib and the third in the middle of the 40-ft. face. These holes are kept as close as possible to the top of the band and are drilled to the full depth of the cut so as to break the band off at the back. The two rib holes are each loaded with 8 in. of black powder and the middle hole with 6 in. This was found sufficient to shoot the coal and band down without an excessive amount of shattering of either the band or the coal. If the band is shot too hard it is broken up so finely that the drillers have difficulty in cleaning it all out. After these shots are fired, the drillers start cleaning the band and shoveling out the bottom coal from the cut. It was found quite practicable to use a regular big dust shovel and a special scraper for this operation. As the band is taken out, it is gobbed and the bottom coal thrown back away from the face of the top coal. The coal from the two corners of the room is thrown away from the ribs so as to make room for the automatic and tail rope jacks of the loader. The work of removing this bottom coal and band is all done by the three drillers on each loader, who in addition to those duties, do all of the timbering for that one loader. It would take one driller an average of one-half shift to clean out the band and remove the bottom coal from a 40-ft. face, undercut to a depth of 5 ft. To date we have not had a single accident due to falls of coal at the face while the drillers were cleaning the cut.

It can readily be seen that by the removal of the band and bottom coal, we have thus produced an ideal snubbing action for the remaining 3½ ft. of top coal to be shot down.

Four holes are then drilled in the top coal, one about 18 in. from each rib and one hole 10½ ft. from each rib. These holes are started 8 in. from the top and drilled up at a slight angle so that the back of the hole is close to the roof. It is necessary to drill them in this manner because the coal at this mine adheres very tightly to the top. Each of these holes is then loaded with one stick of Hercules Red H. C. Dynamite with a No. 6 electric detonator. All of these shots in the top coal are fired simultaneously at the end of the shift.

The drill holes are 1½ in. in diameter and the cartridge only 1⅛ in. in diameter, while the first dummy of tamping next to the explosive is tamped loosely. The difference in diameter between the hole and cartridge along with the loose dummy gives sufficient air space so the speed of the resulting explosion is materially reduced, allowing the gases to expand across through the bedding planes instead of being confined to a small zone close to the cartridge.

The top shot, due to the snubbing action caused by the removal of the band and bottom coal, is rolled out away from the face instead of being set down tight on the bottom. The looseness of the coal makes it easy for the scoop to obtain its full load without having to dig it away from the face, thus producing more fines and reducing the efficiency of the loader. This snubbing of the top coal and the cushioning of the shot gives us a larger percentage of lump coal than we get in hand loading.

Of course, not every face, snubbed and shot down in this manner results in ideal preparation for the loaders. But this method of blasting, closely supervised as it is, has reduced to a minimum the pick work necessary to dislodge the coal and has given us larger production from the loaders.

The cost of removing the band for hand loading is about 10 cents per ton, while the cost under the new system for the mechanical loaders is over 12 cents per ton. But this increase in cost is greatly offset by the increase in lump coal obtained, which amounts to 8 percent over hand loading.

Thus, for a cost of only a few cents additional per ton, a perplexing situation was solved, resulting in more efficient operation for the mechanical loaders and better preparation of the coal in blasting.

MR. N. S. GREENSFELDER, *Hercules Powder Co., Wilmington, Del.:*

Mr. Lyon's paper proves the value of three general courses of procedure that we have advocated for some time.

First, continuous, intelligent, supervision of drilling and blasting.

Second, introduction of cushioned blasting.

Third, determining the right system of drilling and choosing the proper explosive when changing from hand loading to mechanical.

In mechanical loading the coal must usually be freed on both ribs and so shaken up at the back that when the loader advances the coal will fall forward without much pick work.

Squarely undercutting the face, cleaning out the bug dust, using more drill holes with smaller charges, and selecting the proper explosive are aids to better blasting for mechanical loading.

Mr. Theodore Marvin, managing editor of the *Explosives Engineer*, recently compiled a symposium on "Drilling and Blasting in Some American Coal Mines." This study included mines employing hand loading and others where mechanical loading has proved successful.

I would like to call on Mr. Marvin to explain briefly how this symposium was collected and its significance.

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MR. THEODORE MARVIN: When this idea of the collection of coal diagrams was suggested by Professor Raymond, of the Mining Methods Committee of the A. I. M. E., the idea, as put forward, was for the purpose of getting together as many representative diagrams of recent drill and placing methods as are used in American coal mines. The data were collected by writing and sending out circulars to those men in the mines of this country who were closely allied with drilling and blasting operations. From the large number of reports we got back, a number of them were selected and combined and put together into a paper for presentation at a meeting, and since that time have been published.

I think this illustrates one very necessary thing which must be done if we are to improve drilling and blasting methods, or all mining methods, materially, and that is collection and dissemination to all mining men, or all those interested in that subject, of this material and data which can readily be visualized. So that a man who has a particular problem can with little trouble run through the collected data and perhaps find the information and apply the results of some other man's years of experience and of testing and experimentation.

We need a more general dissemination of this sort of material which, of course, is the reason and the value of such a meeting as this one this afternoon. Each year at these conventions we should have more of such papers giving practical data and more discussion of the many methods which are brought up, with the ultimate dissemination, of course, of this material to you men who are here and to those who can not come.

MR. GREENSFELDER: We are very fortunate in having with us today a man who is well qualified, by experience, to talk on blasting preparation for mechanical loading in one of our great western coal mining states. I am going to call on Mr. Otto Herres, assistant to the general manager of the United States Fuel Company, to give us a few remarks on blasting preparation for mechanical loading in Utah.

MR. OTTO HERRES, U. S. Fuel Co., Salt Lake City, Utah: Our mining conditions in Utah are about as radically different from those described in Mr. Lyons' paper as you can possibly imagine. Instead of low coal we have some of the highest coal in the United States. Many of our working places are very high, the roof being 16 to 18 ft., and in some cases in our large mines is as high as 25 or 30 ft.

Instead of having a soft coal with bands of bony or impurities, our coal is clean practically from the roof to the floor with no partings or impurities whatever and is extremely hard. It is probably as hard as any bituminous coal in the United States; blocky and has no pronounced cleavage.

You have heard others from the West, particularly Mr. Dickinson, from the Union Pacific Coal Mines, in which he described conditions, and you have heard from Mr. Schultz, from the Liberty Fuel Company, in Utah, wherein he described their mechanical loading, and you have heard Mr. Bottomley, from the Sheridan district. Those mines are well advanced in mechanical loading. You may wonder why some of the other companies in Utah, who are known as progressive coal companies, haven't had something to tell you. It just brings you back to the proposition that each mine is an individual problem.

Our conditions are radically different from those of Mr. Schultz and Mr. Dickinson and Mr. Bottomley. Mr. Schultz's property has an excellent roof. The coal is about 7 or 8 ft. high. We have an excellent roof, but the coal in our pillars is much closer to 16 to 25 ft. high. Extracting pillars from that height of coal presents certain difficulties, as you may well imagine, in roof control, timbering and safety from falls of coal along the rib.

While we have been working at mechanical loading for a good many years we are still, you might say, in the development stages of it. We have tried a number of different heights in mechanical loading. We started out some ten or twelve years ago with the old style Myers Whaley and the Howe shovels as used in the iron district. Since that time we have tried out the different stages of mechanical loading with conveyors, with scrapers, such as they have in the Union Pacific Mines, with the later types of mechanical loaders, such as the Joy and the Jeffrey entry driver.

Our scraper work met with a different problem than the Union Pacific work for the reason their roof breaks very easily on the retreat and can be readily controlled, while our roof is very strong sandstone and breaks in large blocks weighing very many tons. Our experience has been that it has been impossible to control it. Of course, it is almost out of the question to consider cribbing with such great heights as we have. Our scraper work has been more along the line of the smaller units, such as are used in the metal mines. We have used a small hoist built by the Sullivan Machinery Co. It is very light to handle, portable and quite flexible in its operation, although it will handle a good sized scraper of coal. The hoist we have been working with lately was just about 1 ton, and yet with it we are able to handle a scraper of coal that runs close to 1 ton on a haul of something like 100 ft.

To get to the blasting. You understand the blasting in Utah is different. In order to know anything about it you have to know a little of our blasting system which is also quite different from many districts in the United States. It has been developed largely in the interest of safety of the Utah mines. Ever since the mines were first opened by the company we followed a method of blasting by electricity from the surface when all men are out of the mine. Our mines are non-gaseous, but like most of the mine districts it is generally considered that coal dust is very explosive. For that reason, even before the matter was regulated by law, it was our practice to have all the men out of the mine and shoot from the outside.

We carry an independent shooting circuit from the check cabin to each working face. We have electric wires. The miner drills and loads his holes and connects the powder with an electric cap. That is connected to an independent electric wiring circuit. The miner leaves his working place and throws a switch which connects his place to the district mine. After all the men are out of the mine the fire boss goes in and throws the district switch which connects the district, into the main shooting line. When the fire boss comes out he closes a lightning gap of 6 ft. at the portal of the mine. When all the men are checked out at the check cabin the master switch is thrown which fires all the shots in the mine simultaneously.

Our powder is all permissible powder. We use nothing but the Hercules permissible powder. We haven't used any other kind of powder at least in recent years. Our shooting is all done with an electric detonator. We use a delay exploder. Without our delay exploder all the shots would be fired at one time. To gain the advantage of the time element in shooting we have made use, in some of our working places, of electric detonators that have different speeds, three different ones, that enables us to shoot the center of the face and then the two sides. That way we get the advantage of a better break in the lump.

It may be of interest to you—you have heard a good deal about washing coal of fine sizes in the East—to know that our coal breaks about one-third over 8-in. lumps in size, even with the system of shooting which we use. Of course, that is accounted for by the fact that the coal is very hard and very blocky. These shots are all tamped with a clay that is brought in from outside the mine.

In our work for mechanical loading we found it necessary to deviate a little from our regular practice, but not in any essential respects. At the present time, I think, the only change we have made in our shooting has been that we have had to drill more holes than we used to for the hand loading. When we drill more holes we use less powder per hole so as to break up the coal into smaller lumps for the loading machine, otherwise the nature of our coal is such that it would break into very large lumps which the loading machine might handle but which would give difficulty in the tipple.

We mined a 10-ton lump of coal in one block, I think it was about five years ago, for the State of Utah. We were able to mine that lump in one chunk without any breakage, and shipped it from the mine down a two-mile incline and then to Salt Lake City and took it up a hill to the capitol building, where it is now on exhibition, without developing any cracks in the lump. With that as an illustration you may be able to understand why it is necessary to use a few more holes in the face when we are shooting for mechanical loading.

The appointment has been announced of P. C. Graney as general manager of the Castner, Curran & Bullett Smokeless Coal Co., succeeding P. M. Snyder, who not long ago was elected president of the organization, following the death of Robert Grant, of Boston. Mr. Graney has been associated with the company since its organization several years ago. Among others promoted at the same time were C. R. Stahl, of Stotesbury, who becomes division superintendent, and G. H. Thomas, of Helen, who has also been promoted to be division superintendent. Both have been acting as superintendent in their respective towns. Mr. Snyder had been general manager of the company until a few weeks ago, when he was chosen as president of the organization.

HOW BLASTING EFFICIENCY INCREASES PRODUCTION

Electric Blasting Caps Yield Increase In Production And In Lump Coal

By H. G. MUNDY*

I HAVE spent 24 years of my life in coal mines, two years in the southern part of Ohio and 22 in northern West Virginia, and during this period, and more especially in the past 10 or 12 years, I have been paying particular attention to the different methods of blasting coal.

My first experience in coal mines was in the southern part of Ohio, and in these mines black powder was used, and the miners did their blasting with a needle and squib. At these particular mines this method seemed to be very satisfactory, but in my later years of experience in mines we operate in West Virginia the question has arisen, and we think it a very serious one—the preparation and quality of our coal.

While it is absolutely necessary that we must first have a market before we can have production, it was found necessary that we put in force the most efficient method of blasting the coal, and we therefore installed the electric blasting cap. In the previous years we had been using permissible powder and the blasting was done with cap and fuse, which, I think, is a very poor system. Our production was never what it should have been, and every day on which the mines operated we would have from 6 to 20 men go home on account of missed shots; therefore we would lose the efficiency of these men, and naturally it would result in a decrease in production.

Since the installation of the electric blasting cap we have increased our production materially and have also increased the percentage of lump coal to a great extent.

Under the present labor conditions in West Virginia it is quite hard to successfully introduce new methods where the miners might see the advantage of it. When the electric caps were installed, the question arose among our men relative to the increased cost of blasting, and while naturally, if we used the same method with the electric caps as was in use with the cap and fuse, it would have been a considerable increase in cost, and to offset this extra expense we showed our miners that, by using clay for tamping and then tamping the holes properly, this excessive cost would be more than overcome by decreasing the charge of powder.

With all the methods of blasting which have been used in our mines we feel that, to avoid any violation of the state mining laws, we have now established in our particular mines the most efficient method.

BLASTING PRACTICE AT MINES OF GAULEY MOUNTAIN COAL CO.

(*Continued from page* 537)

Month	% 4-in. Lump	% 2-in. Egg	% Nut and slack	Tons produced per stick Pellet powder	Tons produced per lb. Pellet powder	Average cost per ton to miner
December—26	53.8	13.5	32 7	...	...	.....
January—27	55.7	12.4	31.9	3.6	5.5	$.019
February	47.5	13.6	38.9	3.3	5.0	.021
March	48.8	14.2	37.0	3.0	4.5	.024
April	51.7	12.4	35.9	2.7	4.05	.029

It will be noted that the percentage of lump decreased during the months of February, March and April from that of December and January, with a corresponding increase in nut and slack. Also tons of coal produced per pound of explosives decreased for the same period of time with an increase in cost per ton to the miner. These changes can be accounted for in this way. In the early stages of development of this mine, there was a slate parting about 4 in. underneath the bottom splint coal. This was followed by a streak of coal from 6 to 8 in. thick, and it was in this streak of coal that the undercutting was done. However, as the mine advanced this band of coal became smaller and smaller with the slate increasing until it became necessary to undercut on top of the slate parting and in the splint coal. This necessitated taking bottom for haulage purposes in entries and road width in rooms to permit the loading of large lumps over the sides and ends of the car. A considerable amount of explosives was used for this purpose, increasing the explosives cost per ton of coal mined to the miner and decreasing tons per pound of explosives used.

As satisfactory as the blasting has been progressing at this mine, an increase in lump coal could no doubt be obtained by putting on a shot firer and changing from the miner's squib for igniting to the electric squib. At a time when the mine is a little further advanced and the tonnage justifies it, it is planned to try this method out.

* Superintendent, Century Coal Co., Century, W. Va.

W. J. GERMAN, E. I. du Pont Powder Co. The idea of "Pellett" powder is to have a safer package for those companies that are continuing to use black powder. The Bureau of Mines has proven that the metal keg and the metal jack is a dangerous carrier for powder. It has caused many accidents. Also the practice of taking the powder from the magazines to the homes. In Virginia in the last six or eight months a man opened a keg of powder in his home, filled up his jacks, set the powder off in some way, burned two of his own children and several children belonging to neighbors. They died later.

That is just one of the dangers connected with metal kegs. Some of our states have laws permitting the taking of 25 pounds of powder into the mine at one time. There are some of you who recall the Baltimore tunnel accident in the anthracite field. That is a good example of what the metal keg will do in the way of killing men when the powder is ignited by some electric spark. Somewhere around 90 men, if I remember rightly, were killed in that explosion in 1919, and they were not far from the mouth of the drift when this occurred. Not many of the men were burned.

I just mention these things for you to see what we are driving at. I don't want anyone to get the idea that Pellett powder has been pushed to replace permissible explosives. If in the next two or three years, or in the next five years, black powder has to be legislated out of use in coal mines, the explosive industry will put out suitable permissibles to take care of the demand, but as long as black powder is used a safer package must be used, which is a good thing for that industry.

PRODUCTION OF ASBESTOS IN 1926

THE total quantity of asbestos sold or used by producers in the United States in 1926 was 1,358 short tons, valued at $134,731, according to figures compiled by the United States Bureau of Mines, from individual reports furnished by producers. These figures represent chrysotile asbestos mined in Arizona, and amphibole asbestos mined in Georgia and Maryland. The sales of chrysotile asbestos were much larger both in quantity and value than those of 1925, and the sales of amphibole asbestos showed a decrease in quantity but an increase in value.

Imports of unmanufactured asbestos for consumption amounted in 1926 to 257,621 short tons, valued at $8,142,505, and the exports were 1,104 short tons, valued at $85,922. Corresponding figures for 1925 were: imports, 230,520 tons, valued at $7,134,302; exports, 1,109 tons, valued at $70,846.

The Bureau of Mines will continue after July 1 in an idle condition its oil shale plant in Colorado with the expectation of renewing its experiments after the next session of Congress convenes. Its prior appropriation for operating the plant expired June 30. For the year beginning July 1 it has only an appropriation of $5,000 for maintenance of the plant. A larger appropriation for operation of the plant during the year beginning July 1 failed of passage when Congress at the last session adjourned without approving the deficiency bill. This deficiency measure is expected to be passed shortly after the next session meets and if it contains the oil shale fund the bureau will be prepared to resume operations at the Colorado plant.

REPORTS ON THE MECHANIZATION SURVEY

Four Mechanical Loading Operations In Room And Pillar Mining—Different Track And Haulage Arrangements—Various Types Of Mining Equipment Used

By G. B. SOUTHWARD

THE four reports (Nos. 316, 214, 25, and 29) on mechanized mining which are here submitted, describe mechanical loading in room and pillar mining where the seam and roof have not presented any particularly severe difficulty to the use of this type of equipment. This does not mean to say that the conditions are perfect or ideal—for they are not—it simply means that in these mines the operation of the equipment was the major problem while the physical conditions presented the minor problem. In these four operations, mechanical loaders have been installed without any marked change or departure from the mining system or projection that had been previously used in hand mining; in other words, they are examples of direct substitution of mechanical for hand loading. Some slight modifications from hand mining plans have, of course, been made with the view to increasing the tonnage from a working place or increasing the number of working places in a given area. No. 29 illustrates the latter; in this the room widths are limited to 20 ft., but the breakthroughs are so spaced that each room always provides two working places for the loading machine. No. 316 uses mechanical loaders in entry development, room work and pillar recovery; the others develop entries and drive rooms with machine loading, but make no pillar recovery; in this respect all four mines are following their previous hand-mining practice.

The track and switching arrangements, however, are decidedly different from that used in hand mining—particularly in Nos. 214, 25, and 29—and since all of these have been worked out or designed to provide a regular and constant supply of mine cars at the working face, a comparison or study of these arrangements and their methods of operation is of interest and value. In this study it should be kept in mind that these haulage methods were not designed to meet any special underground physical conditions, but were designed for the purpose of utilizing the transportation equipment already on hand at these mines.

No. 316 uses two gathering locomotives for each loading machine. Mine cars are placed one at a time at the machine by a locomotive which shifts the loads to an adjoining room until a trip of six cars is made up. While hauling this trip to the main-line side track the second gathering locomotive serves the loader. Mine cars are 3½-ton capacity.

No. 214 uses mule haulage in the rooms, two drivers serving each machine, and hauling to the room neck on the heading. Loaded cars are taken down the working room and the empties are brought up the adjoining room and through a breakthrough to the machine, the plan being to have the second driver waiting in the breakthrough to place his empty as soon as the loaded car is hauled away. One gathering locomotive is used for the two loading machines in the panel. Mine cars are 2½-ton capacity.

No. 25 has a haulage system somewhat similar to No. 214 in principle, but the track arrangement is entirely different. Two drivers serve each machine, taking empties from the side track in one room and hauling loads to the side track in the adjoining room, so that there is no interference between the drivers and the empty is waiting to be placed as soon as the loaded car is taken away. Trips are placed at the side tracks by a gathering locomotive which serves six loading machines. Mine cars are 3-ton capacity.

No. 29 uses a double track in each room, and the loading machine is served by one gathering locomotive. Having double track, the machine can load a car on one track while the locomotive places a car on the other. When loading out a breakthrough, three and four car trips are set opposite the mouth of the breakthrough. Mine cars are 1¼-ton capacity.

These four track arrangements and haulage methods seem to be, and are, radically different from one another, but they are all similar in one fundamental; all are in effect using a double gathering unit to serve each loading machine. No. 316 uses two locomotives, Nos. 214 and 25 use two drivers, and No. 29 uses a double track so that the machine is loading on one track while the locomotive is gathering from the other. All are designed to reduce the time required for waiting on cars—No. 316 with a comparative long gathering haul requires a fast transportation speed and uses locomotives, Nos. 214 and 25 using a slower rate of transportation have reduced the length of their haul, while No. 29 provides for loading during time of changing cars.

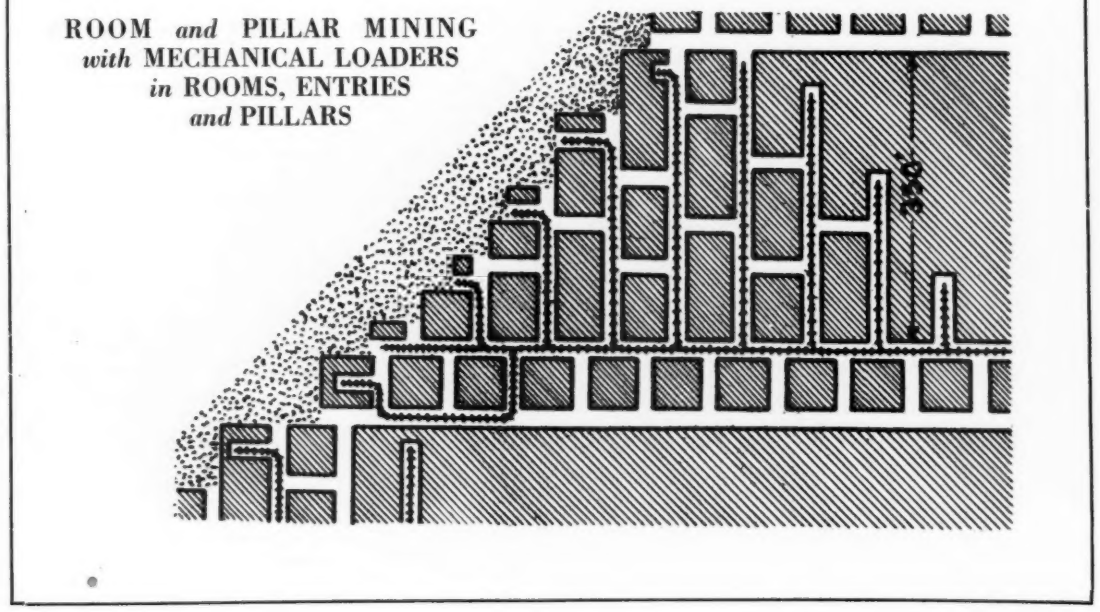
These reports are to show the various methods and the general or average results being attained, and it is not the intention at this time to make comparisons or any attempt to decide which particular method is showing the greater efficiency. All four of these operations are reported by their companies as being economically successful, and since all four are working under more or less similar conditions, there is a temptation to try to make comparisons. However, there are two difficulties in the way of doing this with any degree of accuracy. The first is that none of these loading machines is operated at 100 percent efficiency, and we would have to decide what part of this efficiency loss is due to the methods or system itself and what part is from outside causes. The second difficulty is that these operations have different heights of coal, depths of cut, widths of working place, capacity of mine cars, and so on, and all these variable factors must be reduced to some common denominator before an accurate comparison is possible. However, when additional reports are submitted and there are a greater number of operations to consider than the four shown here, it is believed that certain fundamental principles and fundamental details of operation will stand out as being correct.

These reports are the first of a series which are to be published in THE MINING CONGRESS JOURNAL. Their publication will continue in subsequent issues until all the mechanical loading, scraper and conveyor mining operations included in the mechanization survey have been shown. As has been previously explained, it has been agreed with the coal companies whose operations are being described, that these reports will not publish the names of the operating companies, the geographical location of the mines, nor the name of the manufacturer of the equipment used.

However, in addition to showing mechanized mining as it has been developed and is now being operated, this survey has the further and main object of helping this development to continue. In order to accomplish this, it has been arranged with the coal companies whose operations are reported, that they will permit visits to their mines if they have assurance that such an inspection will be of benefit to the visitor and will further the development of mechanized mining.

It is therefore suggested, that those desiring additional information write the American Mining Congress advising what they desire to know or see. These requests will be forwarded to the companies who can best answer them.

Report No. 316



PHYSICAL CONDITIONS: The seam has an average height of 9 ft. varying from 7½ to 10 ft. The coal is of soft structure with a small bone parting. Slate top which stands well in rooms and headings and breaks well in the pillar recovery. Medium hard slate bottom. Seam nearly level. Cover 100 to 500 ft. Open lights.

MINING SYSTEM: Room and pillar retreating with mechanical loading in entries, rooms and pillar recovery. Panels 400 ft. wide are developed by a pair of entries with rooms 18 ft. wide on 80-ft. centers driven 350 ft. long off one side of the entry. By this method, which is sometimes called the "block system," about 70 percent of the coal is mined from the pillars.

MECHANICAL OPERATION: The system is worked retreating, driving the entries to their panel limit with mechanical loaders and starting the rooms at the top of the entry. As soon as a room has driven up the pillar is started back, carrying the pillar retreat on a stepped line whose general direction is approximately 45 degrees to the heading and extending this pillar line across two or three butt entries. One loading machine is used in a two or three-entry panel, driving the rooms and recovering the pillars.

The room pillars are at times recovered "open end" but more generally cross-cuts are driven 15 or 20 ft. back from the gob line and the stump of coal thus left is recovered by widening the cross-cuts toward the mined area. This method has proved very satisfactory under the top and seam conditions at this mine and a high pillar recovery is reported.

The loading machine works and travels on track and loads into mine cars of 3½-ton capacity which are delivered one at a time by gathering locomotives. Two locomotives serve one machine, using a near-by room as a side track for shifting single loads and hauling 6-car trips to and from the main line side track. The track is laid with 25-pound steel rail on 36-in. gauge in the rooms and headings.

Coal is undercut 7 ft. by machine, cutting about 18 in. above the bottom and under the bone parting. Black powder is used for blasting. Five shots are first placed to shoot up the bottom coal; these are followed by two shots placed to break the bone parting and four top shots bring down the top coal. The coal is well broken so as to eliminate much digging by the machine.

TIMBERING AND ROOF ACTION: Very little timbering is required in heading and room advancement and no great difficulty is encountered in maintaining the top during the pillar recovery although careful timbering is required mainly to hold small pieces of roof during the mining rather than to resist excessive weight. Because of the seam height rather large timbers are necessary, varying from 8 to 10 in. in diameter.

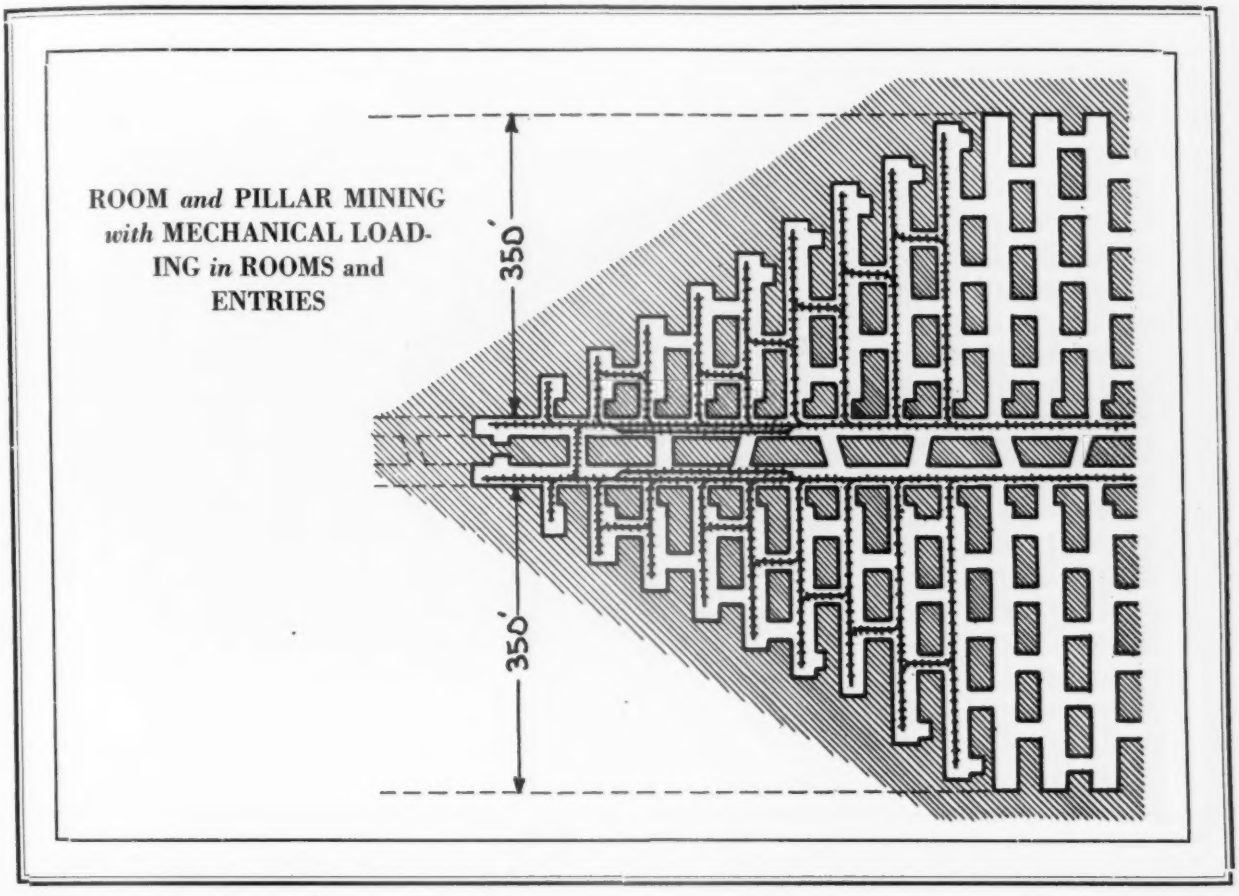
OPERATING CREW: Loading, timbering and track work are done on the day shift with cutting, drilling and shooting on the night shift; both shifts being 10 hours long. Each machine has a regular crew of 9 men—1 machine operator, 2 jackmen, 1 hand shoveller, 1 car trimmer, and 2 gathering locomotive crews of 2 men each. The night crew consists of 2 cutting machine men, 2 drillers and 1 shot firer, a total of 5 men. In addition to these crews, there are generally from 4 to 8 men employed on the day shift for timbering, trackwork, etc. This makes a total crew for each machine operation varying from 18 to 24 men or a general average over long periods of about 22 men. Under fair conditions a machine will ordinarily load out from 7 to 8 places during a shift, each place making approximately 40 tons. An average of 286 tons per machine per shift was maintained over a year's period by a number of loading machines in several mines of this company.

EQUIPMENT: Each mechanical loading operation has 1 loading machine, 1 cutting machine, 1 electric hand drill and 2 gathering locomotives.

PREPARATION: Some slate picking is done inside the mine but picking tables on the tipple are used for both hand loading and machine mining. The management reports that the size and quality of the coal from the machine loading compares favorably with that obtained by hand mining.

CONCLUSION: Mechanical loading experiments have been carried on at the mines of the company about 10 years and the management reports that their mechanical loaders have been on an economical operating basis for the last seven years. During this later period, additional machines have been added until 40 percent of the entire output from all mines of this company is now being loaded mechanically.

Report No. 214



PHYSICAL CONDITIONS: The seam is 6½ ft. high—of fairly hard coal—with a 2-in. slate parting near the bottom. Other small partings occur irregularly, making an average amount of 4 in. of impurities in the seam. Slate top which usually stands well in rooms and headings but some bad top areas are encountered. Medium hard fire clay bottom. Seam level. Cover 600 ft. Open lights.

MINING SYSTEM: Room and pillar advancing with mechanical loading in rooms and entries. No pillars are being recovered. Panels 750 ft. wide developed by a pair of entries in the center with rooms to the right and left. Rooms 28 ft. wide with 27-ft. pillars, driven 350 ft. long. Two loading machines are used in each panel, each machine driving one entry and working 9 rooms on that side of the entry. Hand shovelling on portable conveyors which load into mine cars is also used in several panels.

MECHANICAL OPERATION: The loading machine works on caterpillars which are set at proper gage for moving from place to place on the mine tracks. Mine cars of 2½-ton capacity are placed one at a time by mule and driver, two drivers serving each machine. A single track of 16-pound steel is laid in each room with a switch through a breakthrough to the adjoining rooms. Empties are placed by a gathering locomotive in the room next to where the loading machine is working, in from 10 to 15-car trips, and the drivers take empties from this room through the breakthrough to the machine and place the loads down on the heading and in the neck of the room that is being loaded. One gathering locomotive serves two loading machines in a panel. A side track is maintained near the top of the entry for the entry and room neck development.

All coal is undercut by machines with 7½-ft. cutter bars and the drilling is by electric hand drills. Permissible explosive is used with fuse firing. Five snubbing shots are made immediately over the slate parting and the snubbing crew pulls out this coal by hand and removes the slate. After this, four top shots are made to shoot down the top coal and the place is then ready for the loading machine. About two sticks of powder are used for each of the snubbing and top shots.

TIMBERING AND ROOF ACTION: Roof conditions vary to some extent, but in general four posts are set in a room after each cut. No pillar recovery is made and there is no attempt to maintain the top after a room is completed.

OPERATING CREW: Loading, cutting and drilling is done in the day shift; shooting and snubbing in the night shift. Each loading machine has 1 operator, 1 helper, 1 car trimmer, 3 drivers, 2 hand cleaners, 2 cutting machine men, 1 driller, 2 snubbers and 2 track and timbermen. This makes a total of 15 men on the regular crew with 1 foreman supervising the operating of the two loading machine units in a panel. Two repair men are employed for six loading machines. A machine loads the entry each day and from 5 to 6 rooms additional, each entry producing from 15 to 20 tons and each room averaging 36 tons. During the last month an average of 240 tons per shift per machine has been maintained in one panel.

The portable conveyors have a regular crew of 4 shovellers, 1 driver, 2 cutting machine men who also drill and fire the shots, 1 hand snubber and 1 trackman; this crew will usually load one entry and two rooms each day.

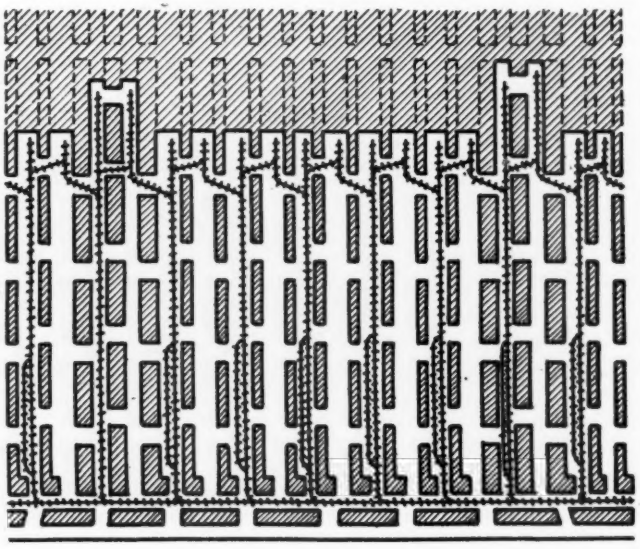
EQUIPMENT: Each mechanical loading operation has one loading machine, one cutting machine, one electric hand drill and three mules.

PREPARATION: The management reports that, with the shooting and snubbing methods used, the percentage of screen sizes prepared compares satisfactorily with hand mining. There is, however, more slate to be cleaned on the surface and the slate picking crew on the tipple has been increased approximately 10 to 12 percent.

CONCLUSION: Mechanical loading has been used at this mine for about two years and the operation is now on a 100 percent mechanical basis and has been so for the last six months. It is considered satisfactory and successful by the management and it has concentrated the mining area and has reduced the number of working places that were formerly required to produce the same daily tonnage by hand mining.

Report No. 25

ROOM *and* PILLAR MINING *with* MECHANICAL LOADING *in* ROOMS and ENTRIES



PHYSICAL CONDITIONS: The seam varies from 6 to 8 ft. in height, of fairly hard coal, with small intermittent slate partings. There is some draw slate, but in general the top is good and stands well with light timbering. Fire-clay bottom. Seam generally flat. Cover 50 to 60 ft. Open lights.

MINING SYSTEM: Room and pillar advancing with mechanical loading in the rooms and entry development. No regular panel is projected; rooms 24 ft. wide on 34-ft. centers are advanced abreast off a pair of entries and are driven an indefinite length. Three rooms with the room breakthroughs are assigned as the territory for one loading machine and several loading machines work at one time in a panel.

MECHANICAL OPERATION: The loading machine loads on caterpillars but moves from place to place on wheels which are removed when at the working face. The machine loads into mine cars of 3-ton capacity which are placed one at a time by mule; two drivers serving each machine and delivering to a side track in the room. One gathering locomotive serves six loading machines, hauling from the room side track to the main-line parting.

A single track of 30-pound steel on 42-in. gauge is laid from the entry to the room face in every second room. The intermediate rooms are reached by tracks laid through breakthroughs near the face to the haulage rooms on both the right and left. This arrangement permits each intermediate room to use the side track in either of the adjoining rooms and it further provides a track connection near the face of the rooms for moving the machines from place to place without traveling down to the entry. As the rooms advance the switches are moved forward so that this track and switching arrangement is always maintained close to the working faces. The rooms are divided in blocks of 10, by a pair of narrow rooms which are intended to serve as a sub-haulway with a cut-off track laid to the rooms in a row of breakthroughs driven in line through the block.

The coal is undercut by machine with a 6½-ft. cutter bar and shot with black powder. Three snubbing shots are placed near the bottom of the seam and are followed by three lighter shots near the top of the seam. No hand snubbing is done, and the time interval between the snubbing and the top shots is regulated by the shot firers. The coal is well broken up so that no digging is required by the machine.

TIMBERING AND ROOF ACTION: No pillars are being drawn as the light cover permits a high rate of extraction in the room mining. The top is generally good and a row of light timbers up the center of the room is sufficient to maintain the top.

OPERATING CREW: A panel of 21 rooms forms an operating unit for seven loading machines, with each machine taking three rooms with the breakthroughs as its regular loading territory. All loading is done on the day shift with the cutting, drilling, shooting, and other dead work on the night shift, each shift being eight hours long. Each loading machine has a regular crew of one operator, one helper, two drivers; and in the entire panel there are five cutting machines, with two operators on each, three electric drills with two men each, one gathering locomotive with a crew of two men, four timbermen, eight trackmen, and two hand loaders. This makes a total of 62 men on the regular operating crew for seven loading machines with one main-line locomotive. Each machine will average from three to five places in a shift, each place producing about 40 tons of coal. Besides the regular work a mechanical and electrical crew of five men is employed, who oil and inspect each machine daily and make such repairs as are found necessary.

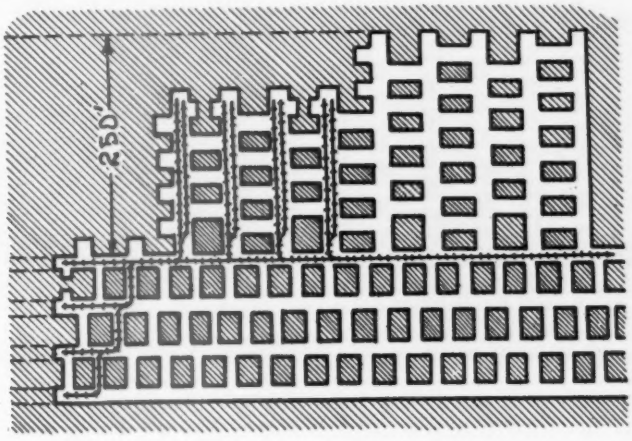
EQUIPMENT: A panel with 7 loading machines uses 7 mechanical loaders, 14 mules, 5 cutting machines, 3 electric hand drills, 1 gathering locomotive.

PREPARATION: No cleaning is done inside the mine, but a small amount of hand picking is done on the surface. The management reports a percentage of lump coal equal to that formerly obtained by hand mining and further reports that no additional slate picking is required.

CONCLUSION: Mechanical loading has been in use at this mine for over a year, and the operation is now 100 percent mechanical. The management considers mechanical loading satisfactory and successful, and the number of working places have been materially reduced from the number formerly required to produce the same daily tonnage by hand mining.

Report No. 29

ROOM *and* PILLAR MINING *with* MECHANICAL LOADING *in* ROOMS and ENTRIES



PHYSICAL CONDITIONS: Seam varies from 5 to 7 ft. in height; fairly hard coal with small intermittent bands of impurities. Slate top which stands well in most areas; but a weak strata from one to two feet thick is frequently encountered and is difficult to hold. Medium hard fire clay bottom. Seam nearly level. Cover 250 ft. Open lights.

MINING SYSTEM: Room and pillar advancing with mechanical loading in rooms and entries. Panels are developed by four entries with rooms driven off one side only. Rooms are 20 ft. wide with 40-ft. pillars between and are 250 ft. long. Breakthroughs 20 ft. wide and 20 ft. apart are turned to the right and left off each room and are driven half way through the pillar to meet similar breakthroughs from the adjoining rooms. By the time one breakthrough is completed—taking a cut each time the room is cut—the room has advanced far enough to start the next breakthrough on the opposite side. This schedule is systematically maintained and as a consequence each room always provides two working places with 50 percent of the coal coming from breakthroughs which require no additional track work. The same method of breakthrough driving and spacing is used in the entry development.

Two loading machines are used in each panel, one driving the four entries and the other working four rooms. With the breakthroughs this makes a territory of eight places for each loading machine.

The machines load directly into mine cars of 1¼-ton capacity, which are delivered in trips of from two to four cars by a gathering locomotive, one locomotive serving each machine. Two tracks of 20-pound steel on 38-in. gauge are laid in each room; the loading machine works between the tracks on caterpillars and loads into mine cars on either or both tracks. After the first car is loaded in a room—clearing the track—there can always be at least two cars placed at one time within reach of the loader and when working in the breakthroughs a four-car trip is placed on the track passing the mouth of the breakthrough. The gathering locomotive uses one of the nearby rooms as a gathering point.

All coal is machine undercut 5 ft. and drilled with an electric hand drill. Black powder is used with four shots in each room. The breakage is not reported as excessive although the coal is broken sufficiently so that no digging is required by the loading machine.

TIMBERING AND ROOF ACTION: It is the intention to recover the pillars but this operation has not yet been systematized. The method proposed to be put into effect is expected to result in a fairly complete pillar recovery. At present the only timbering done is that required to maintain the top for the immediate workings and light posts set in two rows up the center of the room are sufficient where the top is good. In the bad top areas additional and more careful timbering is required.

OPERATING CREW: All work is done on the day shift with exception of the shot firing which is done immediately at the end of the day shift. The cutting, drilling and other dead work follows directly behind the loader. Each loading machine has one operator, one helper, one trip rider, one motorman, two cutting machine men, one driller who also loads the shots, one trackman and one timberman. This makes a total of nine men for the regular crew but additional labor is required in the bad top areas for timbering and slate handling. In the room work an average of five places is loaded each day, each place producing from 20 to 25 tons.

EQUIPMENT: Each operating unit uses 1 loading machine, 1 cutting machine, 1 electric hand drill, and 1 gathering locomotive.

PREPARATION: The coal sizes produced by mechanical loading are reported to compare favorably with those obtained by hand loading. Picking tables are used in the tipple and some additional slate pickers are required over that formerly used in hand mining.

CONCLUSION: Loading machines have been in use at this operation for over a year, and the mine is now on a 100 percent mechanical loading basis, and the operation is considered satisfactory and successful by the management. The plan devised for working rooms and breakthroughs has proved very satisfactory in providing an operating territory in a small area and it is estimated that in this development a tonnage is being produced by mechanical loading which is materially more than what would be produced by hand mining from the same number of working places.

COAL

PRACTICAL OPERATING MEN'S DEPARTMENT

NEWELL G. ALFORD, Editor

Practical Operating Problems of the Coal Mining Industry

SAFETY METHODS AT THE NEW ORIENT MINE

Ventilation Given Special Attention—Mine Is Completely Rock-Dusted—Regular Inspection Of Old And Abandoned Workings—General Safety Committee Meets At Regular Intervals—Safety Rules Adopted — Accident Prevention Depends Entirely On Degree Of Cooperation

By WALTER NICHOLS *

IT IS impossible to give in the space of a short article all of the various methods which are used to prevent accidents. I have, however, attempted to outline briefly below a few of the methods which seem to me most interesting for the purpose of this article and which have been found effective at New Orient.

This mine is operated with closed lights and all men employed underground use electric cap lamps, except the mine examiners. These examiners use flame safety lamps equipped with internal igniters and magnetic locks while making their examination of the mine. Employes are not allowed to enter the mine while it is being examined and not until the examiners have all returned to the surface and made out the daily reports required by law. In these reports the examiners set forth the condition of the mine as they found it. After making up this regular report the examiners then make up a special report giving the places found unsafe for men to work in and which they have fenced off. This special report is turned over to the mine manager and as a special safety measure "Notification of Danger" slips are filled out warning the men who work in the places found in a dangerous condition to stay out until they are made safe and are told by their face boss to go in to work. These slips are made out for each man involved and placed on his lamp in the lamp house. After all the mine examiners have reported to the lamp room the lamps are given out. When an employe calls for a lamp on which there is a "Notification of Danger" slip, he is given this slip to sign. The lamp is then given out and the signed slip placed in the lamp rack in the space occupied by the lamp given out. When all men are in the mine these danger slips are collected and taken to the superintendent's office where a record is made of the conditions found by the mine examiners. A copy of this slip is shown in Figure 1.

The mine manager on receiving his special report from the mine examiners

FORM 440

CHICAGO, WILMINGTON & FRANKLIN COAL CO.
NEW ORIENT MINE

NOTIFICATION OF DANGER

CHECK NO. 176 DATE 3/24/27

YOU ARE HEREBY NOTIFIED TO STAY OUT OF

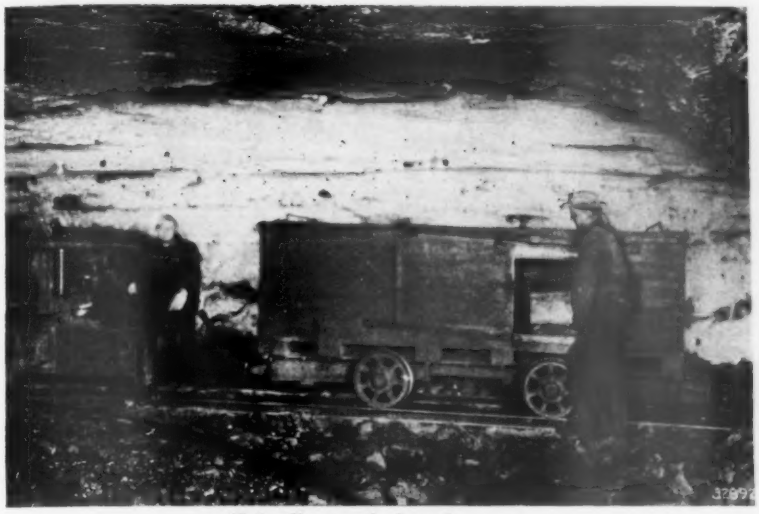
6th North panel Entry off 5th West North

UNTIL SAME HAS BEEN MADE SAFE BY THE MANAGEMENT AND YOU ARE NOTIFIED TO THIS EFFECT.

SIGNED Joe Kominski
LOADER

Fig. 1

* Chief Safety Engineer, Chicago, Wilmington & Franklin Coal Co., Chicago, Ill.



Unloading explosives from car

notifies each face boss about the places marked out as dangerous in his section and instructs them to examine such places and see that they are made safe before the men are allowed to go into them. Each face boss carries a flame safety lamp equipped with internal igniter and magnetic lock in addition to his electric cap lamp, which he uses during the day to see that no gas is accumulating in the entries or worked out rooms in the panels where men are working.

Before men are lowered into the mine an inspection of the guides, cages and hoisting ropes is made by an employe competent and especially designated to do the work. He makes out a daily report stating the conditions of this apparatus as he found them. This same equipment is inspected again at the noon hour and at the close of the hoisting shift before the men are hoisted to the surface. There is a safety device connected with the hoist to prevent overwinding when men are being hoisted. This device is electrically controlled and is switched on when the engineer gets the proper signal. A red light appears both on the bottom and at the ground landing to indicate to the men that this safety device has been switched on by the engineer. No one is permitted to get on the cage until these red lights are lighted. There is a set of lights for each cage.

Large signs are posted at the lamp house and ground landing and on the shaft bottom notifying employes they are not permitted to take into the mine cigarettes or smoking material of any kind. Being a closed light mine smoking is not allowed. To enforce this rule we resort to searching. This is done by selecting a few men from each cage load, it being impossible to search every man because of the lack of time. This system, however, is very effective as none of the men know when they are to be searched. Any employe violating this rule is discharged. A visitor's register is kept at the lamp room in which all visitors going below sign their names. Opposite their names is placed the number of the lamp given them. They also deposit with the lamp man all smoking material as it is his duty to see they do this. The number of the lamp serves as a life check while the visitor is in the mine, but the main purpose of having the register signed is to give the lamp room attendant an opportunity to ask the visitor to leave his smoking material on top.

Each underground employe has a number assigned to him which is his lamp number. No other employe can receive this lamp as the lamp number is also a life check while in the mine. In case anything goes wrong with a lamp while in the mine the man using it must take it to his face boss who has repairs and extra batteries. The battery can be changed but not the head piece as that is the part on which the number is placed. The number of lamps taken out each morning gives us an accurate check of the number of men underground each day. When the men are reported all out at the close of the shift a check is made to see if any lamps are missing. If so, an investigation is made immediately and the missing lamps accounted for. Independent racks are kept for shot firers' lamps and night shift lamps which are handled the same as the day shift lamps.

Ventilation of the mine is given special attention. A record of the barometric pressure, temperature, and electrical consumption of the fan motor and water gage is taken each morning and entered in a book kept for the purpose. The volume of air entering the mine is measured every morning at the foot of the downcast. Air is conducted from the downcast through four air courses for a distance of 1,500 feet. At this point a division is made, two air courses going straight north and two going west. A solid pillar is left between the air courses and haulage roads except openings that were necessary to make for haulage when the air course entries were driven. When an advance opening is made the opening behind is closed with a concrete stopping. All refuse thrown back by the loaders while driving the air course entries is loaded out before the track is removed. Arched concrete overcasts are built at all cross sections and graded to give a uniform area to the air course entry. Each cross section of the mine is ventilated with a separate split of air controlled by regulators from the main air course. Substantial stoppings are built on all cross sections and one way self closing doors are used across haulage roads so as to conduct as much air as possible to the working face. At the entrance to panels on the inlet there is an emergency door built for use in case the regular door should be damaged. In this way we do away with interference with ventilation while doors are being repaired. Readings are taken regularly at the foot of the upcast to determine the percent of methane in the return air from the mine. Readings are also taken at all cross sections return airways to determine percent of methane given off in each cross section.

Main haulage roads are cleaned from rib to rib. Cross cuts between haulage roads are used for refuge places. They are 60 feet apart. No refuse of any kind is allowed to collect in them. Lights are placed on the main haulage ways at short intervals. Extra lamps are placed at all cross sections. A telephone and switchboard are installed and a train dispatcher stationed at these points to direct the trips in and out. The power lines at cross sections where men have to pass under them are guarded with rubber belting. Haulage roads are rock dusted after they have been cleaned. The road beds are kept damp by sprinkling. Men are employed on the main haulage roads to gather up the coal that falls off loaded cars and place it in piles to keep it from being pulverized.

The mine is rock dusted by a special crew of men in charge of a foreman whose duty is to see that the rock dusting is done properly and kept as close as possible to the working face. Air courses and cross cuts are rock dusted. The rock dusting is done by using two machines coupled together; the nozzle of each machine being set at an angle to the rib so that the whole surface of the entry is rock dusted by making one trip through. The machines are operated by

a slow speed locomotive. The men employed at rock dusting are furnished with goggles and dust proof respirators. The efficiency of the rock dusting is checked by taking samples regularly from the roof, rib and floor before and after dusting. These samples are analyzed in our own laboratory at the mine. When a sample shows less than 75 percent incombustible matter the place from which sample was taken is redusted. In taking samples the roof and rib are taken separate from the floor. A record is made of the location where sample was taken and the conditions at the time, that is, whether wet, damp or dry. When samples are taken in the advance entries a record is made of the distance the rock dust is from the working face at that time. A colored tracing is kept on the mine map showing the distance the rock dusting is from the working face and a record of all rock dusting done. When the tracing on the mine map is extended the date the work was done is also put on the map. When panels are worked out and the material recovered the entrance to these panels are re-rock dusted with not less than 90 percent rock dust. These panels are then fenced off close to the haulage road with wire fencing and a hinged gate, locked, so that no one can enter except those whose duty it is to do so.

The coal is undercut with mining machines and the machine cuttings are loaded out before the coal is shot down. Permissible explosives, electric blasting caps and a single shot battery are used in blasting the coal. The shots are fired after the mine has ceased operation and the men are all out of the mine. All power is cut off from the inside of the mine. For powder delivery the mine is divided into sections. Where explosives are being delivered the power is cut off. Specially insulated powder boxes are made and mounted on trucks for explosive transportation and a storage battery motor is used. The explosives are sent into the mine after all the men employed on the night shift are out of the mine except those who are to deliver the powder. While powder is being lowered into the mine the power is shut off the entire mine.

Certified men are employed to make regular inspections of the old and abandoned workings during the day while the mine is in operation. When a panel is practically worked out and commences to squeeze a certified man is stationed there to see that while the rooms are falling gas does not accumulate to create a dangerous condition. When a panel falls and is giving off gas, readings are taken regularly to determine the percentage of methane given off.

There is standing on the shaft bottom a fire truck fully equipped with fire extinguishers, brattice cloth, lumber and

Showing actual size of safety button. The background for the lettering is red and black

the necessary tools to build stoppings to which is attached a 750-gallon high pressure water tank with hose connections, hose and water buckets. This is kept full of water at all times and can be transferred to any section of the mine at any time a fire should break out, or an explosion occur. On the cross sections of the mine at the first panel working there is a fire station equipped with fire extinguishers, barrels of water, water buckets, brattice cloth, extra doors, lumber and the necessary material to fight a fire should one break out.

Safety Measures Recommended to Employes to Prevent Accidents

The extent to which accidents can be prevented depends entirely on the degree of cooperation the company gets from its employes. That is, the company can adopt safety methods and measures to safeguard life and limb, but this is only partially effective. Accident prevention must go farther than this. The employe must work safely and adhere to and observe the safety rules and regulations and cooperate to the fullest extent if preventable accidents are to be reduced to the minimum. It is, therefore, important to give a great deal of time and attention in training employes and in convincing them it is to their interest to cooperate in carrying out safety measures.

A central safety committee was organized of which the vice president in charge of operation is chairman. In addition to the vice president the committee consists of his assistant, compensation superintendent, his assistant, mine superintendents, safety engineer, electrical engineer and the company physician. There is also a Division Safety Committee at each mine of which the mine superintendent is chairman. The other members of the committee are the various foremen, compensation superintendent, his assistant and the company physician.

The Central Safety Committee meets at regular intervals to discuss accident prevention methods and to study the results obtained during the previous period. Special investigations are made into any serious accident to find out the actual cause and responsibility and determine method of prevention in future. Illustrative forms and descriptive literature are worked up on serious accidents to show and explain how such accidents can be avoided. These "Safety Bulletins" are given out to the employes with their pay statements. A safety button was adopted on which is printed our slogan "Play Safe." These buttons are worn by the foremen and other officials of the company while on duty, and when requested they are also given to the employes. We believe this keeps the idea of safety in the minds of the employes at all times. All safety suggestions and recommendations adopted by the Central Safety Committee are forwarded to the Division Safety Committee to be put into effect. Through cooperation of the Compensation Department valuable statistics are furnished to show the number of accidents by mines, the cause, amount of time lost by the injured, and the foreman under which the injured is working and the net cost per ton.

All accidents for the month are analyzed carefully. Accidents are summarized under each foreman who is given an opportunity to explain cause of accidents occuring in his department and what action he has taken or recommends to be taken to prevent them. There is, of course, general discussion and presentation of suggestions from various members of the committee.

The following code of safety rules was adopted by the Central Safety Committee, and is in force not only at New Orient, but at all of our mines:

Employes must not get in or out of man trips except at regularly designated places. Power lines at these stations are protected with rubber belting and provided with cut-out switches. The men must remain seated while the trips are in motion and not attempt to get out until ordered to do so by the foreman in charge. Violations of this rule subjects the employe to discharge.

Lights are installed at short intervals on main haulage roads to give sufficient light to travel by and see to get into refuge places for safety while trips are passing in case the cap lamp should go out.

All crossings at cross sections are well lighted and signs posted cautioning employes to look out for motors and passing trips. There are also signs posted warning the men it is better to be safe than sorry. There are also signs directing the way to the shaft bottom and escape shaft.

As there are two main haulage roads, men must not walk with their back to the motor.

An improved type electric tail lamp is hung on the last car of all trips operating on main haulage roads.

Employes traveling on haulage roads are urged to get into the first refuge place they come to instead of racing to the next one when they see a motor coming. On coming out of refuge place

they are cautioned to look for the tail light on the last car of the trip and see if another motor is following close behind the trip just passed. Our Safety Bulletin No. 5 has reference to this rule.

Employes other than those required to operate them are not allowed to ride on motors or cars unless they have permission to do so by the management. Any employe disobeying this rule is subject to discharge. Safety Bulletin No. 13 shows what happens when this rule is disobeyed.

Employes are cautioned not to carry drills, tamping bars, or any tools on their shoulders while passing under power lines. Safety Bulletin No. 11 illustrates proper and improper way to carry tools.

Loaders are instructed not to drill their holes deeper than the machine cut, or close to the rib. Unexploded shots are not to be drilled out, as it is safer to drill another hole. Coal must not be used for stemming. Fire clay only is to be used for this purpose.

Loaders are cautioned to see that their cars are securely blocked before commencing to load them. When the places are down grade they are asked to set a prop in front of the car to prevent it from moving over the end of the track and running against the face. They are also asked not to stand between car and coal face when loading, or when they are prying down coal.

Employes are instructed not to enter their working places or any part of the mine that has been fenced off and marked "Dangerous—Stay Out," by mine examiners or the management. To do so is to risk their own life and the lives of all the men in the mine. Safety Bulletin No. 6 illustrates method of fencing off dangerous places.

No employe, other than those charged with the operation thereof, shall attempt to operate, or operate, or in any way tamper with any motor, car, switch, mining, loading or shearing machine or any other machinery, apparatus or electrical appliances in and about the mine, whether on top or below. Any employe violating this rule is subject to discharge.

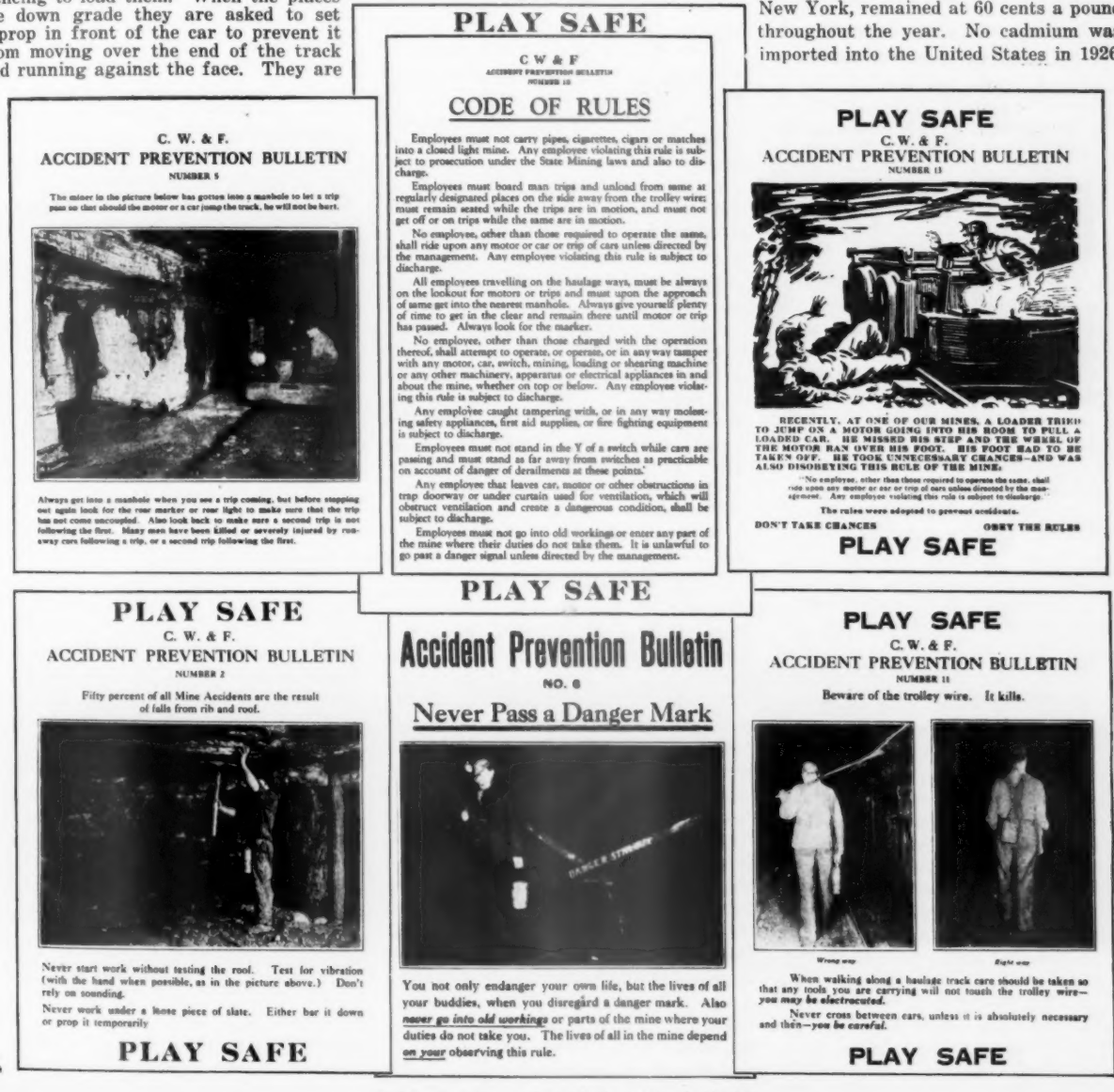
Any employe caught tampering with, or in any way molesting safety appliances, first aid supplies, or fire fighting equipment is subject to discharge.

Employes must not stand in the Y of a switch while cars are passing and must stand as far away from switches as practicable on account of danger of derailments at these points.

Any employe that leaves car, motor or other obstructions in trap doorway or under curtain used for ventilation, which will obstruct ventilation and create a dangerous condition, shall be subject to discharge.

METALLIC CADMIUM PRODUCTION

THE production of metallic cadmium in the United States in 1926 amounted to 810,428 pounds, valued at $429,527, based on the average selling value of 53 cents a pound, as reported by producers to the United States Bureau of Mines. These figures represent an increase of 61 percent in quantity and 55 percent in total value, as compared with 1925. The market quotation on American metal, New York, remained at 60 cents a pound throughout the year. No cadmium was imported into the United States in 1926.



Code of rules and typical safety bulletins

MINE ACCIDENT PREVENTION

Cut-throat Competition Contributory Factor—Mines Can Be Made Safe—Recommendations To Reduce Toll Include Use Of Proper Equipment And Care In Employing And Managing Men—State And Nation Should Safeguard Life And Health Of Miners

By WILLIAM BONCER*

GEOLOGISTS tell us that the greatest thickness of the stratified rocks of the earth's surface is estimated to be about 20 miles, while the average thickness is 5 miles or more, and that the carboniferous or coal age ranges from 8,000 to 16,000 ft. in thickness. While the coal measures are very small in proportion to the thickness of the stratified crust of the earth, yet they vary and have enormous thickness in some places. In Pennsylvania they are about 4,000 ft.; in West Virginia 6,000 ft.; in Oklahoma 8,000 ft.; in South Wales 12,000 ft.; in Nova Scotia 13,000 ft.

It is not my purpose in this paper to discuss geology as such, but to discuss coal-mine accidents and their prevention. A phase of coal-mine activity which affects the health, happiness and prosperity of the men who are engaged in taking from the earth a product which enters into the comforts and welfare of all of our people. In order that you may have some idea of the depth of our coal measures and be able to imagine the difficulties that may be encountered in penetrating the earth for some of the coal I have given the geological data. Through geology and science we have learned a great deal about the minerals of the earth and their values, and through the same sources we have learned how to safely, economically and profitably extract them. Coal being a basic product, vitally necessary to the operation and further development of all of our industries, it is necessary that we use all known safety measures in safeguarding the lives and limbs of the workmen that produce this valuable product, and at the same time conserve this limited fuel supply to posterity.

ACCIDENTS

Each year about 2,500 men are killed in our coal mines and computed at the rate of 6,000 productive days' labor we have a direct labor loss to the industry of 15,000,000 man-days per year. However, this is only one part of the loss that must be charged against the industry as a result of these accidents. To this must be added the stoppage temporarily of employes engaged where the accident occurs, the shaken morale, the labor turnover resulting therefrom, and many other losses which can not be computed in dollars and cents, all of which do affect the cost of coal to the consumer.

One of the outstanding contributory factors at this time which should be eliminated in order to assist materially in reducing accidents is the cut-throat competition in the selling of coal. Prices at the mine are entirely too low to permit a reasonable margin of profit, a part of which should go into the upkeep and improvements of the mines.

Another factor is that many men now working in the mines never have and never expect to make mining their permanent calling. These men are largely farmers and mix one job with the other. Many of them do not understand mining and are not interested enough to learn; where there is lack of discipline they go on in a careless way, not only jeopardizing their own lives but the lives of others. If they happen to be dismissed for one cause or another they merely pick up what tools they have and go to another mine and secure work.

To the man who has always made mining his occupation the change in systems and equipment is a factor against safety. It is an old saying that it is hard to teach an old dog new tricks. It seems to be natural for human beings that have been in the habit of doing things a certain way for a long time to get into a rut out of which it is hard to get. And this does not apply to the miner any more than to any other class, but it does enter into our mining problems today, and much educational work will be necessary to eliminate it.

Wasteful and careless methods of operation by employers create careless and negligent employes. When the average man secures employment at a mine he will come very near forming the habits and practices of the employer and the other officials. If a good system is maintained in development work, if timbering is properly done, supplies neatly put away where persons can get them when wanted, and other work done in a clean and safe way, it will not be long before the miner is doing things the right way or he will voluntarily leave the mine. Many mines have been planned and worked with no thought given to the providing of safe roof conditions. Too often the mine pillars have not been commensurate with the depth and nature of the overlying strata; the nature and character of the bottom; thickness and character of the coal and the pitch of the seam. The pillars may have been drawn close to the haulage roads, manways and airways. As a result of such negligence the roof has been disturbed and broken along the haulage roads, and the airways choked with falls, thus creating dangerous conditions in working places. All mines should be planned in such a fashion so as to retain the maximum stability of roof until the coal has been worked out and the mine abandoned.

We know how to properly timber and support the roof, yet hundreds of men are killed, and thousands injured annually because timbering is not properly done. In fact, this is the chief cause of mine accidents.

I believe another serious factor in the great loss of life and the injuries to large numbers of men is due primarily to the feeling on the part of officials and inspectors at mines that the occupation of mining is naturally a hazardous one, and that, therefore, mine accidents are naturally a daily and annual occurrence. The idea that a mine can not be made safe should be dispelled. Let the president of the mining company, the directors and other company officials become personally interested in the elimination of accidents. Let accident prevention come first on the list of matters to be considered at board meetings, then pass the word down the line to the lowest official that a continuation of accident frequency means dismissal and we shall soon see a great reduction in both fatal and non-fatal accidents. There are several operations now being conducted on such a basis, under which accidents have dropped off to a surprisingly low level. There are incompetent officials in charge of some mines who daily look upon careless practices by men in their employ and take no action to correct such carelessness. Let me call to your attention the fact that the manufacture of the explosives used in mines—the most hazardous industry we have—is now the safest. The manufacturers of explosives recognized the hazard problem and then solved it by putting into effect methods that have made the industry comparatively safe. The records of the explosives manufacturing companies show that they have practically eliminated accidents. When we reach the point where the practice of safety is made a condition in the employment of supervising mine officials,

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we shall have begun a campaign of safety that will virtually eliminate coal mine accidents. Many men employed in mines are given to careless and dangerous practices, absolutely taking chances and doing things which they know have injured others, and we believe that the only way by which thoughtless men can be prevented from doing these things in the mines is to keep them out of the mines, and this should be done. On the other hand many men do things they should not do and are injured because of the force of circumstances. We know that the law of averages is against the person taking chances, but how many men are there that will not take a chance at one time or another to add a few pennies to the day's pay when they know that their families at home need shoes and clothing, or as we sometimes see it at the mines, where the miner waits for his day's earnings to be turned into the office so that he may draw script on the store to purchase food for supper, and breakfast and dinner for the following day. We are convinced that an important factor connected with accidents is a low and inadequate wage, and as long as the unsettled and unstable condition now prevailing in the coal industry exists the operator will not have the funds to maintain the necessary safe conditions in the mines. Nor will the employe receive wages sufficient to prevent him from taking the chances which he thinks are necessary to make both ends meet.

Accident Statistics

I had the pleasure recently of listening to an after-dinner talk on the coal question by a coal operator. Among other things, he stated that he could not tell whether mine accidents were increasing or decreasing, but he believed that if the ratio was based on the number of people employed we would find they were not decreasing, and that there possibly is a slight increase.

I have tried to come to some conclusion on the subject myself. I have read articles and consulted tables from various statisticians, both Federal and state, as well as those of insurance companies and safety engineers and executives of private corporations. My interest has been intensified in this subject because of efforts that are being put forth in my own state, Virginia, in mine safety work for the past year or year and a half. At no time in the history of coal mining in Virginia have such efforts been made to prevent accidents as during the period referred to, and these efforts are continuing and growing. I want to encourage this good work by assisting in developing a plan for the gathering of statistics which will tell us just where we are and what progress we are making. Personally I believe if there is any change there is a slight increase.

The most comprehensive article I have read on the subject of accident statistics is one written by the Hon. Ethelbert Stewart, Commissioner of Labor Statistics of the Department of Labor, in which he advocates the reporting of man-hour exposure together with the number of men and number of accidents. This article appeared in the June, 1926 number of the American Labor Legislation Review. I believe all of us are convinced that there should be some uniform national system of accident reporting so we shall have some idea of where we are in accident prevention work.

Recommendations

What is true of accident statistics is also true of safety regulations. There are some basic safety regulations which could apply to all coal mines and which I believe should be made national as a minimum standard. I will give you a few which I think should be adopted.

(1) Permissible electric lamps should be used in all coal mines, and the use of open flame lamps and smoking should be prohibited. Flame safety lamps, magnetically locked, should be required for testing gas.

(2) All undercutting machines should be equipped with a water line connection and the operators required to keep the fine coal and dust made by the machine so moist that it will ball when pressed in the hand. All loaded cars should be sprinkled before leaving the face.

(3) All bituminous mines should be rock dusted with fine dust of not less than 20 mesh on the roof, floor and ribs, at not less than 65 percent. Rock dust barriers should also be properly placed to prevent the propagation of explosions.

(4) All blasting should be done with permissible explosives and should be fired electrically.

(5) Each mine should be so ventilated that methane could not accumulate in dangerous quantities.

(6) All main haulage entries should have a height of not less than 5 feet from the top of the rail, and not less than 3 feet clearance on the wide side. All timbers necessary on haulage roads should be set into the rib so that the outside of them will be flush with the face of the rib.

(7) All electrical installations should be put in conduit or otherwise safely guarded in a mine.

(8) Trolley motors should be prohibited and permissible storage battery motors used in all gaseous or dusty mines.

(9) All blasting of coal or rock should be done by competent shot-firers, and all persons except shot-firers should be out of the mine when the blasting is done.

(10) All officials including fire bosses and shot-firers that are in a supervisory capacity in coal mines should be required to have a certificate of competency.

The adoption of a program of this kind would, I believe, reduce to a minimum accidents in mining operations.

One of the first duties of state or nation is to care for the welfare of the citizen. The bulk of our adult population is gainfully employed in mine, mill, factory, or in agricultural pursuits. The majority of these workers have dependents—the future citizens of tomorrow.

Is it not the duty of state and nation to safeguard, by law and by every other possible means, the lives and health of the work people of our nation? Should we not do our part in advancing any plan, educational or moral, to prevent disease, to prevent accidents, and to prevent the misery and suffering to the family, which inevitably follows an accident to the breadwinner. Great progress has been made in this important field, and I believe that in the next few years our country will set an example to all other countries of the world in the humanitarian work of safeguarding the lives and limbs and health of the men and women of labor.

BARITE AND BARIUM PRODUCTS

SALES of crude barite in 1926, as reported to the Bureau of Mines, by domestic producers, amounted to 232,875 short tons, valued at $1,743,293. These totals indicate an increase of 2 percent in both the quantity and value of sales, as compared with 1925.

Of the crude barite, both domestic and foreign, consumed in the manufacture of barium products, 65 percent was used in lithopone, 23 percent in ground barite, and 12 percent in barium chemicals. Foreign crude barite imported for consumption in this country in 1926 amounted to 51,016 short tons, valued at $195,004.

Barium Products

Combined sales of the barium products —ground barite, lithopone, and barium chemicals—by domestic producers amounted to 234,806 short tons, valued at $18,509,090, in 1926. As compared with 1925, sales of barium chemicals combined increased 17 percent in quantity, sales of lithopone increased 10 percent, and sales of ground barite increased 7 percent.

The lithopone industry which recently has been confined to Illinois and the Middle Atlantic states was carried to the Pacific Coast by the establishment of a plant at Oakland, Calif., by the Chemical & Pigment Co., Inc. Missouri remains the center of the ground barite industry.

INDUSTRIAL RELATIONS AT WEST KENTUCKY COAL COMPANY

Program Adopted At This Property Has Enabled Employes To Work For Twenty-One Years Without Losing A Day's Time On Account Of Labor Troubles—Employes' Mutual Benefit Association An Important Factor In Maintaining Good Will

By C. F. RICHARDSON *

THE West Kentucky Coal Company, operating mines in western Kentucky, employing an average of 5,000 men and producing annually 4,000,000 tons of bituminous coal that is pleasing customers from Louisiana in the South to Canada in the Northwest, has experienced an unusually happy condition for many years which has resulted primarily from their exceptionally fair and honest dealings with their employes, through their employes' organization known as the Employes' Mutual Benefit Association.

This organization has been the medium through which the employes have been daily brought closer and closer to the heart of the company, and it has formed a tie between the executives and the employes that can not be shaken by the most persistent agitation or the most trying conditions that may exist. It has spread to the citizens of the community wherein it operates and a happier condition is not to be found anywhere in industry.

Our experience has taught us that the successful operation of any company, regardless of what business it may be engaged in or what conditions may surround it, depends in a large measure on the mental attitude of the employes toward their employing company, toward themselves, their fellow workers and toward the community wherein they reside. To maintain the proper mental attitude a policy must be established that upholds fair dealing, justice and good fellowship, and then that policy must be lived up to religiously. This does not refer to coal mining alone, as it has worked the same in many departments of our company which cover farming, river and rail transportation, building river equipment, construction crews, mining and selling coal, operating stores, etc.

"Rome was not built in a day," and neither can an organization such as we have be built in a day, or a year; however, it would surprise anyone to know how soon the foundation can be laid, and the results will come just as a greater confidence is established through fair and honest dealing with every proposition that may confront you. It is very easy to be fair on the things that are to your advantage, but the things that really count are to be just as fair and honest when things are against you.

Our association was established September 1, 1918, as a voluntary organization and started out with 513 members, and its growth never ceased until today its membership covers every employe in the service of the West Kentucky Coal Company, from the highest executive officer to the trapper boy. Through it the membership enjoys advantages such as have never been given by any other organization of its kind known to the working man. The initiation fee is $1.00, and the monthly medical fee is $1.00 for married employes and 75 cents for single ones, this amount covering all the costs that are chargeable to the membership for the E. M. B. A. activities and entitles the membership to the following financial advantages:

Free medical attention for self and dependent family.

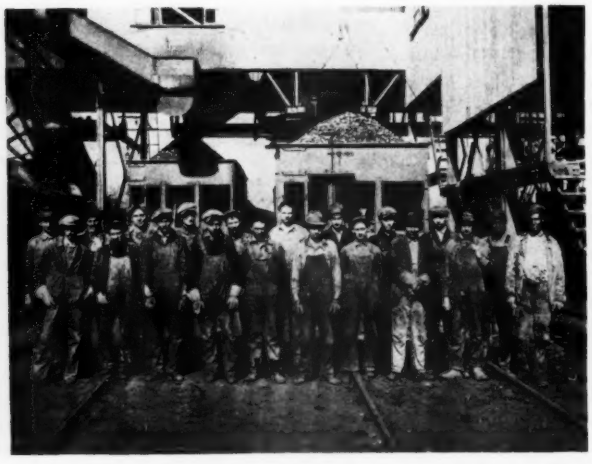
Death burial benefit of $75.00 in case of death.

One dollar per day sick benefits for each day sick in excess of the first seven days up to twenty-one days at which time they receive the first seven.

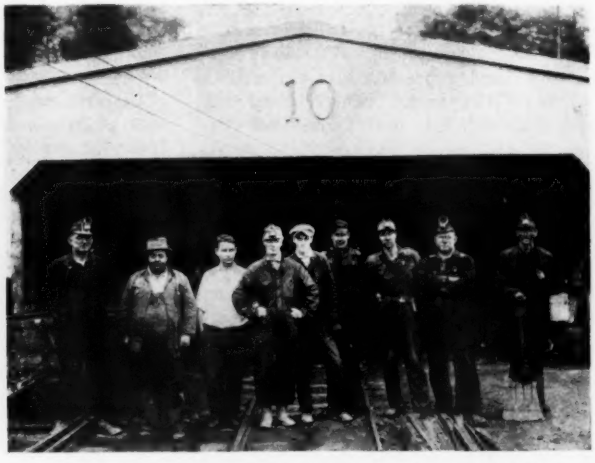
Pension privileges after fifteen years of service, such pension being payable either through disability or after having attained the age of sixty years. After the proper service of fifteen years has been attained any disability entitles one to the pension for fourteen years except such disability as may be caused from occupational illness or accident. When the age of sixty has been reached and the fifteen years or more of service has been had the employe may retire on a pension for life. The minimum pension provided is $20.00 per month, or $240.00 per year; however, the amount of pension is determined by taking 1½ percent of the average annual wage for the last ten years and multiplying it by the number of years in the service.

The many other advantages offered by the E. M. B. A., however, seem to me to be the real advantages, which are:

* President, West Kentucky Coal Co., Sturgis, Ky.



A standard type steel tipple and tipple crew of the West Kentucky Coal Company



The latest development of a slope mine of the West Kentucky Coal Company at Wheatcroft, Ky.

Collective bargaining for wages, hours and conditions of labor.
Social and recreational activities.
Educational activities.

In addition to the above mentioned advantages the company has a group insurance arrangement whereby each member of the E. M. B. A. is entitled to an insurance policy for $500.00 ninety days after their employment, such insurance to increase $100.00 with each year's service until a maximum of $1,000.00 is reached. The cost to the insured is one-half the premium on $500.00, the balance being paid for by the West Kentucky Coal Company, and the increases are all taken care of by the company. The present cost to the employes on this plan is 37 cents per month.

The organization is financed by the company putting into the treasury $1.00 for each $1.00 paid into the treasury by the employes.

The association physicians receive the money put into the treasury for dues by the employes in payment for their service, and such service is carefully watched by the E. M. B. A. officers so that we may know at all times that first-class service is being given.

With the money furnished by the company sick and death benefits are paid and the usual activities of the association are carried on.

A magazine is published monthly, known as *The Progressive Miner*, and is 9 by 11¾ in. and has 36 pages including the cover. The magazine has proven to be a great stimulant for interest, as it carries messages that could not be gotten forcibly before the men otherwise.

Four full-time employes are actively in charge of the organization, which are an executive secretary, two assistant secretaries and a stenographer, and in addition to keeping complete records of employment, service, sickness, insurance records, etc., they edit *The Progressive Miner* and hold bi-monthly meetings of each district of the organization, and do such work as is necessary to promote safety work, a fraternal spirit and aid in the work of adjusting grievances.

The governing board of the E. M. B. A. is seven men, four of whom are elected by secret ballot by the employes and three of whom are appointed by the writer. This council handles all the business affairs of the association, passes on all bills, arranges all contracts, and is the highest court of the association.

Each mine or department has its own district organization, which is composed of a chairman, who presides at the district meetings; a secretary, who keeps the necessary records; a pit committee, that handles the grievances between the foreman and the employes; a safety committee, that does such work as is necessary to make safety conditions around the mine what they should be; a sick or visiting committee, that looks out for the unfortunates to see that they are not overlooked while ill or suffering from accidents or injuries; a lookout committee, that sees to it that each new member understands the workings of the E. M. B. A. and knows exactly what to expect of it and knows what the E. M. B. A. expects of him; and a program committee, that aids in the arranging of programs which will bring the greatest entertainment and pleasure to the employes on their meeting nights.

Type of house provided by the West Kentucky Coal Company for its employes

The fact that our employes have worked for twenty-one years without losing a day's time on account of labor trouble is proof enough that the employes have the fullest confidence in their employer—and such confidence is not a myth, but has necessarily been built up by fair dealing at all times. In 1924, when the St. Bernard property was taken over by the West Kentucky Coal Comany, a strike was on that could be settled only by the men taking a reduction in wages of 20 percent. Immediately the E. M. B. A. won the confidence of these men, and in a very short time 90 percent of them were at work and happy, and today we find them to be among our most faithful and loyal workmen.

This sign is displayed in a prominent place at each mine or at the headquarters of each department

We stand today as a big family all working for the same result, to be of better service, to make our communities better places in which to live and rear our families, and to bring about those conditions which will result in our being more happy and contented, and with the accomplishment of these things we fear not but that unlimited success is inevitable.

The success of our organization has been very much stimulated from the fact that is has only promised that which it could give and has always given all that it has promised.

The West Virginia Coal & Coke Co. announced recently that J. W. Bischoff for some time general superintendent of the Elkins or northern division of the company has been made general superintendent of all operations of the company, with headquarters at Omar in the Logan field, where the company has its general operating office. Other changes announced by the company include the appointment of W. G. Whitman, formerly division superintendent in charge of the Splint Division of the company at Omar, as division superintendent of the Elkins division, succeeding Mr. Bischoff; the appointment of J. T. Fallon, for some years superintendent of the Coalton operations, as superintendent at Omar in Logan County and the appointment of A. R. Hewitt, formerly general mine foreman and assistant superintendent of the Norton plant, as superintendent of the Norton and Coalton plants. Mr. Bischoff has long been prominent in mining affairs of the state, having been at one time president of the West Virginia Mining Institute.

METALS

PRACTICAL OPERATING MEN'S DEPARTMENT

GUY N. BJORGE, Editor

Practical Operating Problems of the Metal Mining Industry

ESTABLISHING SAFETY RECORDS AT OLD DOMINION COMPANY

Splendid Results Have Been Attained Through Creation Of Safety Committee Composed Of Representatives Of Workers And Management—Credit For Results Given To Arousing Interest Of Entire Personnel—Wholehearted Cooperation Of Entire Organization Established

By W. G. McBRIDE*

CONCERNING our safety record for the year 1926, which appeared in the March, 1927, issue of THE MINING CONGRESS JOURNAL these very gratifying results were not brought about by changes in methods, safety devices, or by any revival meeting methods, but are rather the result of cumulative efforts extending over several years. These years of effort have at last succeeded in arousing a keen interest in the safety movement on the part of our entire organization, including practically every workman on the job. Our efforts during the past have, of course, given us valuable experience and brought to our attention many unnecessary hazards which have been eliminated, but I believe that the most important thing has been the arousing of interest among the rank and file of the workmen and the convincing of everyone on the job that a great many of our accidents in the past have been avoidable.

It may be of interest to review briefly our experience in this work. The first step was the appointment of a safety inspector. Later committees were organized for the purpose of assisting the inspector and of increasing the interest of the men and bosses in the movement. It was early ascertained that the tendency was to unload all of the responsibility upon the safety inspector, and it has taken a lot of effort to get the supervisory force and the workmen convinced that safety could only be brought about through the united efforts of everyone on the job. At first the organization consisted of workmen's committees for the surface and underground departments, which inspected the plants monthly, the safety inspector acting as secretary, and made recommendations for changes to eliminate hazards. These recommendations were then passed up to a central safety committee made up of the members of the supervisory force which, after consideration of the recommendations, either disapproved them or ordered the recommendations put into effect. The central safety committees also took up, on their own initiative, matters which came to their attention and which offered possibilities of reducing accidents. It was found that most of the recommendations of the employes' committees were sound, and very few of them were disapproved by the central committees. The most serious defect in this system, however, was the delay in putting into effect the recommendations of the workmen's committees, which tended to make the workmen feel that the company was not entirely sincere in its efforts. An attempt was made to remedy this defect by having the committees take up with the bosses concerned any minor matters which could cheaply and quickly be remedied. In the mine department the experiment was made of combining bosses and workmen on the inspection committees, but there was still the difficulty of delay on certain recommendations. Finally, in 1925, it was decided to change our organization to get more prompt action throughout.

At the present time our safety organization consists of a general safety committee, composed of members of the supervisory force, and departmental committees made up jointly of workmen and members of the supervisory force. The safety inspector is secretary of all committees. A departmental committee in each case has the head of the department or his assistant as chairman. In the mine department the general foreman is chairman of all mine committees. There is a committee for each foreman's run, with three workmen from the run and the foreman as members. Each departmental committee makes a monthly inspection of all work being done in the department; it reviews all accidents occurring in the department and considers ways and means of preventing accidents. It has authority to immediately order the installation of safety devices, changes in methods, or anything which it deems necessary for the safety of the men. In the underground workings the committee rates each working place according to the

* General Manager, Old Dominion Co., Globe, Arizona.

safety conditions found and the rating is chalked up in a prominent place—"E" for excellent, "G" for good, etc. Where the committee finds men disobeying safety regulations it immediately takes action in disciplining the men concerned. This discipline ranges all the way from a five-day lay off to discharge. The workmen members of the committee serve a three months term, and it is found that the service on this committee is the best educational feature we have been able to obtain in the safety movement. These committees have been a great help in increasing discipline as applied to the safety movement, increasing the interest of the workmen, and in eliminating hazards. Due to the tact employed by the chairmen of these committees, no trouble has been experienced in getting the workmen members to freely criticize any condition presenting a hazard, even though this criticism involves the supervisory force. The chairmen of these committees make it a point to convince the men at the first meeting that both they and the company mean business in the safety work and they want the freest and frankest discussion in the committee meetings and inspections.

The general safety committee is presided over by the general manager as chairman and consists of the heads of departments, chairmen of departmental committees, and one foreman. All are permanent members of the committee except the one foreman, who serves for three to four months and is then replaced by another foreman. This committee reviews and classifies all accidents, prescribes general rules for the safety movement, devises ways and means of enlisting the support of the men, and maintains a general supervision of the departmental committees and of the safety movement.

Each month a conference of all foremen and bosses connected with the mine department, together with the superintendent and general manager, is held, and there is a similar conference of all superintendents, foremen, and bosses of the surface departments. These conferences are presided over by a chairman chosen by ballot, who holds office for one year, and the safety inspector is secretary of the conferences. These conferences review accidents coming under their jurisdiction, pass on new safety regulations, and discuss any aspect of the safety movement brought up by a member.

It has been found that this new scheme of organization is better in many respects than the old one. It secures more prompt action where changes are necessary to reduce or eliminate hazards, and has produced a more general interest both among the workmen and the supervisory force. It has convinced the men that they have a responsibility in the safety movement and the entire supervisory force that safety is of major importance in the operations of our plant. In addition to the committees outlined above, we make use of temporary committees to investigate accidents, decide on the cause, and fix the blame. These temporary committees are formed by the boss, who immediately after an accident picks up a committee of two or three men and makes a written report of the findings. These investigations are not confined to time-lost accidents, as we try as far as possible to investigate all accidents, no matter how slight the injury. In the more serious injuries an investigation is also made by the departmental committee.

It is of interest to note that this company went from November 29, 1926, to January 26, 1927—58 days—without a time-lost accident. During that time they worked 35,593 eight-hour shifts in the mine. In all departments they went from December 20, 1926, to January 26, 1927, without a time-lost accident, during which time they worked 34,562 shifts. They now have one underground shift boss who has not had a time-lost accident in his run since January 8, 1926. Another has had none since January 29, 1926; a third since March 31, 1926; a fourth since May 15, 1926; a fifth since June 3, 1926; a sixth since June 9, 1926. In their surface departments the Sample Mill has not had a time-lost accident since October 29, 1924; the Mine Blacksmith Shop since May 27, 1925; the Electric Shop since June 6, 1925; Surface Roustabout Gang since July 29, 1925; and the Mine Department Surface Employes since December 3, 1925.

Every effort is made to stimulate interest among the workmen by the use of bulletins, safety flags, posting lists of injuries, etc. One of the most successful devices has been the employment of a large circular shield carrying the words: "No Accident Here Since ———," with a blank space in which is inserted the date of the last lost-time accident. These shields are placed in a prominent position at shops, power houses, concentrator, etc. When the department has gone 30 days, a large five-pointed silver star is hung in the center of the shield. When the department goes 60 days without an accident the silver star is changed for a gold star, which remains until an accident occurs. In the smaller shops we are getting excellent results from individual star boards on which is posted the name of each workman, and a star is placed opposite his name for each month that he goes without a time-lost accident. Provision is also made for keeping this record up to date by providing spaces for years. A star under a year means that the man had no time-lost accident during that year. A button is given to each man going six months without a time-lost accident, and this is replaced by another type of button when he goes two years, and by the highest type of button when he goes five years without a time-lost accident. When a man quits or is discharged he is entitled to a certificate showing the time he worked without a time-lost accident. These are but a few of the devices we employ to stimulate interest, as we find that it pays to keep constantly changing or adding to the interest-stimulating devices, as men gradually lose interest through monotony.

We have found that the competitive spirit is a great help in our accident-prevention work, as it stimulates the sporting instinct of the workmen. Formerly we tried to keep up this spirit of competition between the different departments and the different bosses in the same department. In this, however, we were handicapped by the difference in the hazards of the different departments. In 1925 Mr. P. G. Beckett, vice president and general manager of Phelps Dodge Corporation, and consulting engineer for the Old Dominion Company, organized the Phelps Dodge General Safety Committee with a view to stimulating interest in safety work in the different branches of the company. This committee is presided over by Mr. Beckett as chairman and has a member from each of the Phelps Dodge branches and from the Old Dominion Company. This committee meets quarterly, formulates general rules for the classification of accidents, exchanges information in relation to the accidents at the different places, the methods that have been successfully used to reduce accidents, and possibilities for further improvements. Mr. Beckett has provided a trophy for the branch, showing the best frequency rate during the year, and for the year 1927 will also provide a trophy for the branch showing the best severity rate. He has also provided trophies for the different departments at the various branches which are awarded on the frequency basis. This has introduced competition between the different branches where the hazards are more nearly equal and has been a great stimulus to the safety movement at the Old Dominion Company. The comparative results are tabulated each month and are eagerly awaited by the men in our organization. They have evidently had a similar stimulating effect at the Phelps Dodge branches, where some most wonderful records have been obtained. Through the (*Continued on page* 562)

THE NEW UTAH COPPER TOWNSITE AT COPPERTON, UTAH

This Company Spent More Than Half A Million Dollars In An Unsuccessful Attempt To Develop Satisfactory Living Conditions For Its Employes In The Canyon—Now They Have Built An Entirely New Camp Just Outside Canyon

By H. E. MUNN *

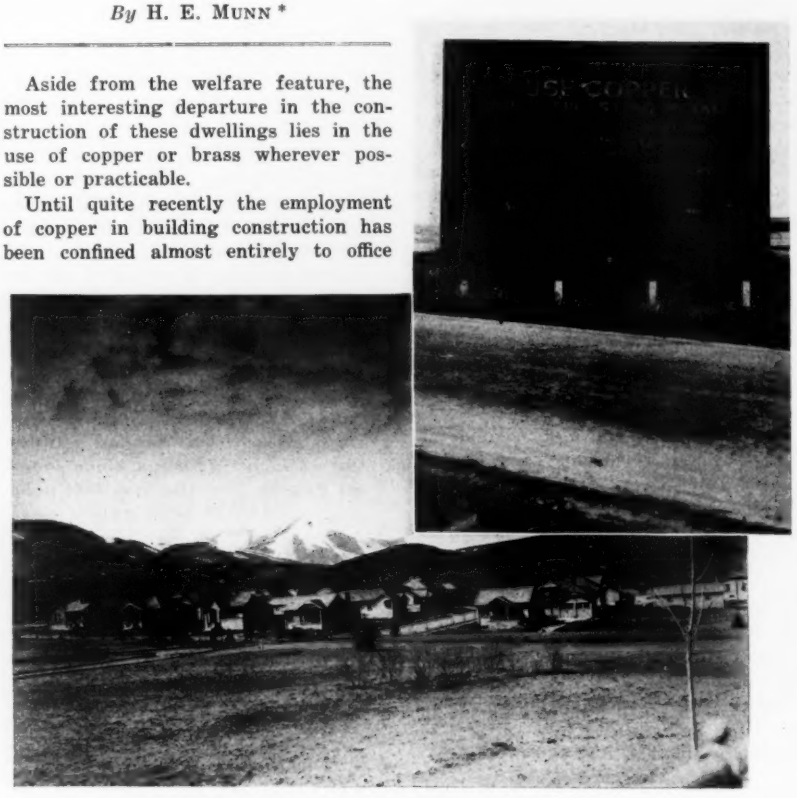
THE Salt Lake Chamber of Commerce estimates that in 1926 approximately 28,000 persons made the 30-mile auto trip from Salt Lake to Bingham Canyon, Utah, primarily for the purpose of seeing the famous open-pit workings of the Utah Copper Company. Aside from mining, this trip holds much of interest from a scenic and economic standpoint, which factors add much to its popularity.

If it were possible to analyze the individual impressions of the thousands of visitors who make this trip annually, it would probably be found that chief interests centers around the housing and traffic congestion in the canyon proper. The housing problem itself has proven an extremely difficult one for the management of the Utah Copper Company, faced as they are with the necessity of affording suitable accommodations for a large number of mine employes.

During the past ten years the company has spent over half a million dollars in the construction of dwellings, dormitories and club houses in an attempt to better living and recreational facilities. Construction has been of a high order in all cases, but lack of room and topographical difficulties have raised building costs to an almost prohibitive figure. In addition, results obtained were comparatively unsatisfactory, due principally to the fact that the disagreeable features incident to living in the canyon, with its adverse atmospheric and sanitary conditions, were not eliminated. While a considerable improvement was obtained from a strictly housing standpoint, it did not keep pace with the demand or the ideas of the management regarding the welfare of their employes. This resulted, early in 1926, in the decision to begin the construction of a new town site on a company-owned tract of land located outside the canyon entrance, approximately two miles from the mine. The new location, which possesses an excellent building topography, is bordered on the north by the Salt Lake-Bingham concrete highway and affords, to the south and east, an unrestricted view of the valley and the Wasatch Range beyond—a sharp contrast to conditions obtaining with the narrow confines of Bingham Canyon. An excellent water supply, which will be described in detail later, has been developed, and every convenience provided to make this an ideal location.

Aside from the welfare feature, the most interesting departure in the construction of these dwellings lies in the use of copper or brass wherever possible or practicable.

Until quite recently the employment of copper in building construction has been confined almost entirely to office and public structures where its value from the standpoint of permanence has been well recognized. This situation has led the building public generally to disregard the possibility of using copper to any extent in residential work, having in mind that the increased cost was not warranted. That such a small volume should be used for ordinary construction appears to be due primarily to the public's lack of definite knowledge regarding the relative cost of using copper shingles and other copper metal work, as compared to the usual materials. In the construction of the 18 houses under consideration, careful costs were kept for the purpose of comparison, with the result that it is now known that the use of copper and its alloys, to the extent outlined, increases the cost only 5.8 percent, or an average increase of $310 per building.



View of Copperton from Recreation Park

Considering the great durability of copper in comparison to cheaper materials, with consequent lowering of maintenance and depreciation costs, it is thought that the use of copper in home construction will receive considerable impetus within the next year or two. The *Iron Age*, issue of January 6, 1927, states:

"Prior to 1921 the consumption of copper in the building industry was negligible. In 1922, with a total building volume of $4,920,000,000 the building industry consumed 164,000,000 pounds of copper. In 1926, with an estimated building volume of $5,500,000,000 copper consumption will increase to at least 275,000,000 pounds, a growth in 5 years of 111,000,000 pounds, or 68 percent."

The article further states that:

"The potential market for brass pipe in existing residences in this country is 2,000,000,000 pounds annually and that the annual potential market in new constructions is over 100,000,000 pounds. The rapid strides which have been made in the development of the copper-clad shingle and the use of copper flashings, gutters, and down-spouts, has opened up an additional potential market, which will consume at least 48,000,000 pounds of copper annually."

* Utah Copper Co., Salt Lake City, Utah.

Typical five-room dwelling

Typical four-room dwelling

From the above it will be seen that builders in general are beginning to recognize that, at a relatively small additional cost, they can improve the structural features of their houses, obtaining the lasting qualities and lower maintenance costs afforded by the use of copper.

Construction

The contract for the first Copperton unit called for the construction of 18 hollow tile, stucco finish houses, consisting of one nine-room, superintendent's residence, nine five-room houses of four designs and eight four-room houses of four designs, garages, construction of streets, curbs, gutters and sidewalks. The specifications covering the work were carefully detailed and called for work of the highest order in all departments. A few items taken from the specifications will indicate how extensively copper and its alloys were employed in displacing the ordinary building materials.

Roofing: Copper-clad strip shingles laid with copper nails.

Valleys: 16-oz. sheet copper placed with copper nails.

Hips and Ridges: Cut from copper strip shingles.

Flashing and Counter Flashing: 16-oz. sheet copper.

Downspouts: 16-oz. sheet copper 2-in. by 4-in. section.

Gutter Straps: 16-oz. sheet copper.

Downspout Stays: Ornamental copper castings.

Chimney Saddles: 16-oz. copper sheet.

Kitchen Vents: Copper globe ventilator and pipe.

Joist Vents: Covered with genuine bronze fly-screen.

Window Screens: 16-mesh genuine bronze.

Door Screens: 16-mesh genuine bronze.

Plumbing: Starting 5 feet outside of foundation, all pipe of brass with brass fittings.

Showers: All brass combination shower and needle bath.

Toilets: Brass hinges and floor flanges.

Building Hardware: Bronze plated.

The floor plans of the dwellings comprising the original unit were laid out with the idea of obtaining the most advantageous arrangement for a given design. Particular attention has been paid to kitchen layouts, ample built-in features and other conveniences being provided. Floors in general are laid with vertical grain fir, oak and maple being used to some extent in the superintendent's and mine engineer's residences. Bathrooms are models of convenience and are furnished with a good quality of fixtures. Basements are well lighted and comprise in all cases laundry, furnace and fruit rooms. No expense has been spared in providing all the necessary outlets for electrical appliances. All houses are equipped with furnace heating plants, 17 being of the usual hot air type and one an oil-fired hot-water system.

Water Supply

A very satisfactory water supply has been developed from a well located near Lead Mine Spur, about a half mile from the townsite. This well, which gets its supply at 110 ft., is equipped with an electrically operated triplex double acting deep well pump, having a capacity of about 5,000 gallons per hour. The pump operates against a head of 185 ft., discharging into a covered concrete reservoir having a capacity of about 250,000 gallons. From the reservoir the water flows by gravity to the distributing system, affording an average pressure of 35 pounds per square inch at the house services.

Ample fire protection is provided by means of 6-in. branch lines run from the main water system to hydrants centrally located in each block. All hydrants and hose lines are conveniently housed in compartments built into the four-car garages.

Sewage Disposal

All houses are connected with a modern sewage system extending approximately 4,000 ft. from the townsite to the discharge in the main canyon. The main artery of the system is 10-in. size with 4-in. standard waste pipe outlets and 6-in. branch feeders.

Electric and Telephone Service

All houses are supplied with underground service connections of 110-220 volts, a type of construction rapidly gaining favor from the standpoint of maintenance and efficiency. The absence of pole lines adds greatly to the neat appearance of the townsite, the increased cost of this type of connection being more than offset by this factor.

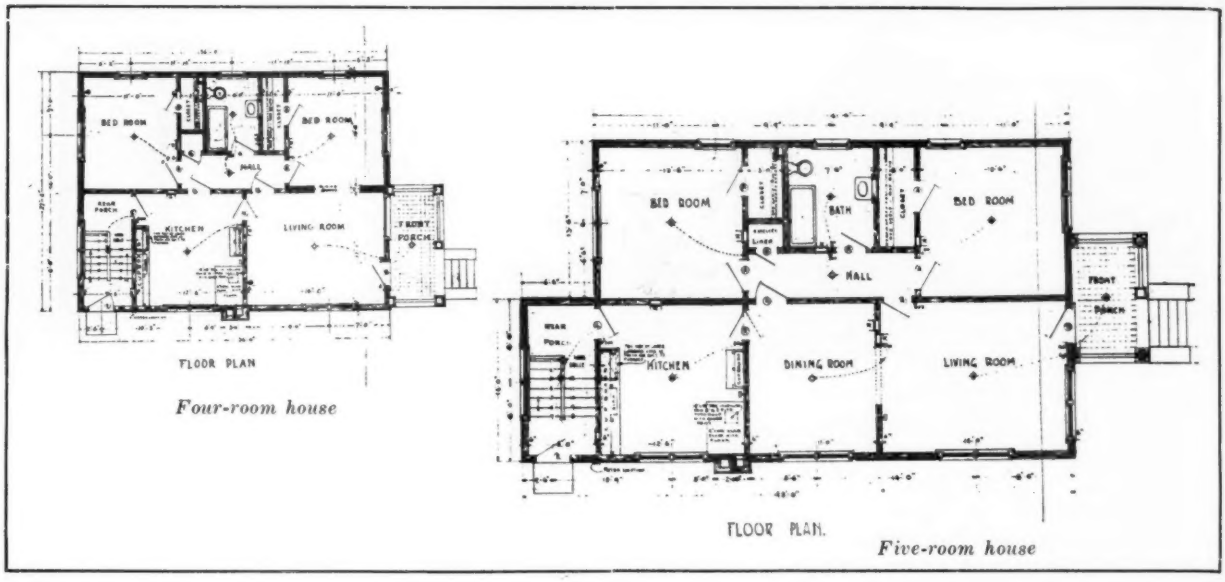
At the present time only one rural line is available for telephone service, but additional facilities will be provided by the telephone company in the near future.

Streets and Parking

The north side of the present unit faces directly on the Salt Lake-Bingham concrete highway and is served on the other sides by 26-ft. streets paved with gravel over a coarse crushed-rock subbase. Streets are all curbed and guttered and are provided at the necessary points with storm drains connected with the main line sewer. Ample cement sidewalks and house approaches are provided, the sidewalk parking being lined with shade trees on 20-ft. centers.

Recreational

The choice of this particular location was fortunate in that the natural topography is well adapted to improvement from the standpoint of park construction. Realizing the necessity of providing recreation as well as housing, the company has parked a seven-acre tract lying immediately south of the townsite and east of the ball park. This tract has been laid out with winding walks, bordered with shade trees of every available variety. Thousands of shrubs have been planted and the grass has already been sown, so that within a year or so the park will be known as one of the garden spots of the district. A circular



Four-room house

Five-room house

concession stand is located in the middle of the park, and two comfort stations matching the architecture of the dwellings are provided. A strip on the south is being reserved for a children's playground and will be fully equipped with all the latest devices for the amusement of the youngsters. In addition, two tennis courts will be built in the southeast corner in the very near future.

The ball park, situated south and west of the townsite, is one of two built by the company for the use of the Copper Baseball League, which normally comprises the Utah Copper Mines, Magna Mill, Arthur Mill and the Utah-Apex teams. This league furnishes some of the best and most highly contested games to be seen in the west.

All parking bordering sidewalks as well as the park proper are equipped with an extensive lawn sprinkling system, some 1,600 sprinkler heads being installed for this purpose.

Auto Parking

An excellent auto parking space has been provided for those attending the games at the ball park. A tract measuring roughly 300 ft. by 300 ft., adjoining the park entrance, has been fenced with heavy woven wire fencing supported on iron-pipe posts. Parking space within this enclosure is bordered by curved concrete curbs and gutters providing parking space for approximately 255 cars. This space has been filled in with a coarse crushed rock subbase topped with gravel, well rolled to grade, and provided with ample subdrainage.

Schools

At present truck transportation is provided for school children between Copperton and Bingham, but a school building will be constructed at the townsite during the present year.

Transportation

Quick and convenient transportation is provided between Salt Lake and Copperton by the Bingham Stage Line. The distance is 23 miles and the trip can be made in about 45 minutes, which places Copperton in the status of being a suburb to Salt Lake City.

Expansion

Foundations are already staked out for 25 additional houses which will be built during the coming year. Five of these will be located in the southeast corner of Block "B" and 20 will occupy a strip bordering the park on the east, known as Block "D." Construction in general will duplicate the first unit with possibly some variation in the design of floor plans. It is the intention of the management to build up the townsite gradually until enough houses are available to take care of all employes whose duties do not demand their constant presence at or near the mine.

The tract lying directly west of the ball park has been subdivided into some 57 building lots upon which the company will either build houses for employes or aid them in building their own homes, but at the present time no decision has been made as to which plan will be undertaken.

From reports obtained from those families already occupying homes at Copperton there can be no doubt as to their attitude toward the new location. The absence of dirt and smoke makes housekeeping a pleasure for the women, and an abundance of fresh air and play room is proving a boon to the children. Certainly if there is anything in the saying that "contented employes pay dividends," the Utah Copper Co. will reap a handsome return from this new development of an already extensive employe welfare campaign.

Acknowledgment is here made to Messrs. J. D. Shilling, superintendent of mines; George C. Earl, engineer in charge of construction, and other company officials who have supplied much of the information contained in this article.

SALT PRODUCTION IN 1926

THE salt produced for sale or use by operators of salt mines, wells, and ponds in the United States in 1926 amounted to 7,371,600 short tons, valued at $25,055,012, according to reports furnished by the producers to the Bureau of Mines. These figures show a decrease of less than 1 percent in quantity and of 4 percent in value from the figures for 1925. The states showing the largest output in 1926 were as follows: Michigan, 2,260,320 tons, valued at $7,594,418; New York, 2,001,580 tons, valued at $6,564,829; Ohio, 1,164,400 tons, valued at $3,209,473; Kansas, 729,880 tons, valued at $2,741,534; and Louisiana, 520,400 tons, valued at $2,457,875.

The salt content of the brine produced and used in the manufacture of chemicals in 1926 amounted to 3,037,820 short tons, an increase of 8 percent over 1925. The producing states were Michigan, New York, Ohio, and Virginia.

The quantity of bromine recovered from natural brines and sold or used in 1926 by the producers amounted to 1,245,760 pounds, valued at $426,837. This is a decrease of 20 percent from the quantity reported in 1925. Brines in Michigan, Ohio, and West Virginia furnish the bromine.

Calcium chloride (including calcium-magnesium chloride) recovered from natural brines in 1926 amounted to 82,340 short tons, valued at $1,710,405, an increase in quantity of 21 percent over 1925.

THE NEW UNITED VERDE HOSPITAL

New Hospital With Fifty-Bed Capacity Just Completed—Has Three Floors And Is Of Reinforced Concrete Construction—Latest Sanitary And Surgical Facilities Included In Arrangement Of This Efficient And Attractive Building

By W. V. De Camp*

THE new United Verde Hospital, one of 50-bed capacity, is owned and operated by the United Verde Copper Co.

The hospital has three floors and a basement, and is of reinforced concrete construction. The first floor consists of a dispensary for the out-patient department, a physio-therapy department, kitchen and dining rooms, store rooms, bed rooms for cook and porters. The dispensary is made up of a reception room, three doctors' offices, a pharmacy, and minor surgery. The physio-therapy department has the usual equipment found in a progressive industrial hospital, and has a capable attendant in charge. The kitchen is equipped with an electric range, electric steam table, and dishwasher. A York machine provides refrigeration and also makes 200 pounds of ice daily.

Two views of the United Verde Hospital

The second floor consists of four wards with eight beds in each, and two at each end of the building opening on to sun porches, two private rooms, an X-ray department, a laboratory, a treatment room, offices of chief surgeon, nurse's chart room, diet kitchen, record room, and hopper room. The wards are segregated into clean surgical, medical, pus and convalescent wards. The X-ray department has the usual equipment, the major pieces being a King III Wappler X-ray machine, a portable machine, a combination radiographic and fluoroscopic table, balance cassette changer for stereo roentgenography, wappler stereoscope, tubular overhead control system. The laboratory is equipped to do only ordinary routine work; Wassermann and tissue examinations are sent to commercial laboratories.

The third floor contains the surgical pavilion, nine private rooms, two semi-private rooms, nursery, diet kitchen, treatment room and hopper room. The surgical pavilion is made up of a major surgery, delivery room, scrub room, sterilizing room, surgical supply room, and instrument room. The major surgery is tiled with a light green flat finished tile and is lighted with a Scialytic light. The delivery room is tiled in the same way as the major surgery. The rest of the pavilion is in white tile, and all private and semi-private rooms have private baths in white tile.

In the basement there is a locker room for patients' clothes, a laundry room for the sorting of linen—as all laundry is sent to a commercial laundry—ambulance entrance, boiler room, two garages, engineer's room and rooms for refrigerator and storage battery. The storage battery is capable of furnishing lights for 12 hours in case of an emergency.

The hospital is equipped with an Otis elevator, which runs to the roof, a spacious place surrounded by a 5-ft. wall, making an ideal spot for sun treatment. The flooring throughout the building is battleship linoleum, except for the surgical pavilion and bath room, where the flooring is of gray tile.

The new hospital has unusually complete equipment and ample space. The medical and surgical staff have the very best material and equipment to work with, so that the most efficient service can be rendered. Every effort has been made to give a homelike atmosphere to the patients' rooms and wards. Tinted walls, resilient floors of battleship linoleum, fine lighting fixtures, and attractive easy chairs all suggest comfort and good taste. In addition to these things, there are private telephones to private rooms and a radio for every bed. All wards open onto a solarium, which is furnished with comfortable chairs and rockers as well as tables for reading material and cards. The solarium on the third floor has a similar equipment for the use of all private-room patients.

The total cost of constructing this hospital was $230,079.82. The cost for new road, excavation, engineering, and inspection was $24,048.57. New equipment, which includes refrigerator and Otis elevator totals $13,706.05. The architects who planned the building were Lesher & Mahoney, of Phoenix, Ariz., while Robert E. McKee Co., of El Paso, Tex., had the general contract.

An extensive park program has been announced by the United Verde Copper Co., Jerome, Ariz., Robert Tally, general manager. Jerome has been particularly lacking in park facilities, due to its topography, and it is now proposed to put a large park and playground on the 300 level on the old slag dump. This is to be a complete grass-covered park with modern playground apparatus.

*General Mine Superintendent, United Verde Copper Co., Jerome, Arizona.

WESTERN DIVISION TO HOLD ANNUAL CONVENTION

Mine Taxation, Mine Stabilization, And Workmen's Compensation To Feature Salt Lake Meeting—Ore Dressing Problems Before Institute

MINE taxation, stabilization of the mining industry, and workmen's compensation will be the principal themes for discussion at the annual meeting of the Western Division of the American Mining Congress at Salt Lake, Monday, August 22. On the two days following ore-dressing problems will be considered at sessions of the American Institute of Mining and Metallurgical Engineers, which is joining with the Western Division in providing the combined program. The details of the sessions of the Western Division are being developed by a committee, consisting of J. O. Elton, J. M. Boutwell, O. N. Friendly, Otto Herres, C. T. Van Winkle, and J. W. Wade, and will be announced later. The meeting of the institute will be in the nature of its annual regional conference, and because of its combination with the meeting of the Western Division, will be the principal session to be held by the institute this year.

The meeting of the Western Division will be divided into two sessions, morning and afternoon of August 22. It will be called to order by Imer Pett, of Salt Lake, chairman of the Western Division, with Louis S. Cates, of Salt Lake, former president of the American Mining Congress, presiding over the first session. At an evening meeting a motion-picture film of the Bureau of Mines on the copper industry will be shown.

The program for the meeting of the institute will be as follows: August 23, morning session, non-technical presentation of the Relations of Flotation to Mining, Smelting and the State, J. O. Elton, manager, International Smelting Co., Salt Lake, presiding.

Definition, Present Status and Future of Flotation, Ernest Gayford, General Engineering Co., Salt Lake. Flotation and Park-Utah Consolidated Mines, Paul Hunt, mine manager. Flotation and Utah Copper Mine, E. E. Barker, engineer of mines. Flotation and Lead Smelting (Blast Furnaces), Richard A. Wagstaff, assistant manager, American Smelting & Refining Co., Salt Lake. Flotation and Lead Smelting (Sintering), W. H. Eardley, manager of smelter, Utah District, United States Smelting, Refining & Mining Co., Salt Lake. Flotation and Lead Smelting (Zinc and Fluxes), A. B. Young, assistant manager, International Smelting Co., Salt Lake. Flotation and Copper Smelting, R. W. Senger, superintendent, American Smelting & Refining Co., Garfield, Utah. How Flotation has Broadened the Geologists Field, Paul Billingsley, consulting geologist, Salt Lake. What Flotation Means to Utah, W. Mont Ferry, managing director, Silver King Coalition Mines Co., Salt Lake.

Afternoon session: Technical papers on Flotation in the United States and Canada. Galen H. Clevenger, consulting metallurgist, U. S. Smelting, Refining & Mining Co., Boston, and chairman, Milling Committee of the Institute, presiding.

Flotation at International, Utah, by a member of the International Smelting Co. staff. Flotation at U. S. Smelting, Refining & Mining Co. Plants, A. B. Marquand, assistant to general manager, Salt Lake. Flotation at Utah-Apex Mine, L. K. Jacobsen, metallurgist of Bingham. Flotation at Combined Metals Reduction Co. Plant, Bauer, Utah, R. J. Evans, Jr., superintendent of flotation. Flotation at Consolidated Mining & Smelting Co. Plant, R. W. Diamond, general superintendent of concentration, Trail, British Columbia. Flotation at the Hecla and the Callahan Plants, W. L. Zeigler, mill superintendent, Hecla Mining Co., Gem, Idaho.

August 24, morning session: Dorsey A. Lyon, superintendent, Salt Lake Station, Bureau of Mines, presiding. Technical papers on Flotation by other speakers to be announced later.

Milwaukee Journal.

Shades of '49

Afternoon session: Round-table discussion of refractories and reverberatory practice, Chas. R. Kuzell, superintendent smelter, United Verde Copper Co., Clarkdale, Ariz., presiding. G. L. Oldright, hydrometallurgist, Bureau of Mines, Salt Lake, secretary.

Discussion of mill balls and crushing, Dorsey A. Lyon, presiding. In the evening the delegates will make a trip to the Saltair Beach resort at Great Salt Lake.

The Bureau of Mines and the Department of Metallurgical Research of the University of Utah are arranging an exhibit in connection with the program to illustrate the subjects discussed.

To Inspect Mines

Thursday, August 25, will be given over to pleasure trips for the delegates, who are expected from all of the principal western mining states. Opportunity will be given the delegates to visit Utah mines and plants, the arrangements for these features being in charge of the following committee: W. J. O'Connor, H. A. Tobelmann, Thos. F. Kearns, J. Wm. Knight, W. Mont Ferry, A. B. Young, Forrest Mathez, and T. P. Billings.

Business sessions of the board of governors of the Western Division, the Board of Directors of the American Silver Producers' Association and the General Tax Committee of the American Mining Congress will be held on the call of the chairmen of these organizations during the sessions of the convention.

Other committees which are making arrangements for the conventions are as follows:

Executive—Imer Pett, chairman; D. D. Moffat, vice chairman; A. G. Mackenzie, secretary; M. J. Dailey, J. C. Dick, J. O. Elton, G. W. Lambourne, E. J. Raddatz.

Finance—M. J. Dailey, H. M. Hartmann, D. D. Muir, Jr., J. A. Norden.

Hotel, Registration and Hall—E. E. Barker, J. C. Dick, D. MacVichie.

Printing, Publicity, and Badges—Ernest Gayford, Michael J. Callow, W. H. Eardley.

Ladies—Walter L. Penick, L. F. Rains, R. A. Wagstaff.

NATIONAL COAL IN CONVENTION

Chicago Meeting Of National Coal Association Considers Research, Production And Price Problems—E. C. Mahan, Of Knoxville, Tenn., Chosen President—Sales And Accounting Features Of Trade Discussed

MEETING at Chicago June 15-17 for its tenth annual convention, the National Coal Association drew a representative gathering of producers, as well as purchasing and sales agents, for discussion of marketing problems of the industry, and selected Edgar C. Mahan, president of the Southern Coal and Coke Company of Knoxville, Tenn., as its new president. Mr. Mahan has been a director in the association during the past 10 years and is well and popularly known in the coal trade. From 1913 to 1915 he was president of the Southern Appalachian Coal Operators' Association. He is an officer and director in 12 coal-operating coal companies and is also a director in financial and mercantile institutions.

New vice presidents of the association were elected as follows: J. B. Pauley, of Chicago, president, J. K. Dering Coal Company; P. J. Quealy, of Kemmerer, Wyoming, president, Gunn-Quealy Coal Company; G. H. Caperton, of Charleston, W. Va., president, New River Coal Company; and F. S. Love, of Pittsburgh, Pa., president, Union Collieries Company.

The following were elected directors of the association: J. H. Bowling, of Lexington, Ky., president Crawford Coal Corporation, representing Eastern Kentucky; T. B. Davis, of New York, president, Island Creek Coal Company, and W. D. Ord, of Landgraff, W. Va., president, Empire Coal & Coke Company, representing West Virginia; Moroni Heiner, of Salt Lake City, vice president, United States Fuel Company, representing Southern Wyoming and Utah; Robert E. Lee, of Chicago, president, Consolidated Indiana Coal Company, representing Iowa; J. W. Searles, of New York, president, Pennsylvania Coal & Coke Corporation, representing Pennsylvania; and A. B. Stewart, of Baltimore, president, Davis Coal & Coke Company, representing Maryland. C. E. Bockus, of New York City, president, Clinchfield Coal Corporation, was reelected treasurer, and Harry L. Gandy, executive secretary.

The convention was held at the Edgewater Beach Hotel, and, in addition to the main sessions, there were meetings of sectional committees of bituminous operators' purchasing agents, coal sales managers and agents, and operators' cost accountants and auditors, as well as meetings of the directors. A banquet was held the evening of June 16 and a luncheon for local association presidents and secretaries. The convention was called to order by President Walter Barnum and W. L. Robison, vice president of the Youghiogheny and Ohio Coal Company, presided over the first session June 15. At this session reports of the officers and membership and trade information committees of the association were rendered, and an address was delivered by George E. Frazer, of Frazer and Torbet, of Chicago, on the use of budgets. Following this meeting a luncheon was tendered the board of directors. In his report as president and chairman of the executive committee of the association, Mr. Barnum praised the vision and activity of the organization. He pointed out that the association had demonstrated to the public that the coal industry is efficient and capable of working out its own problems without governmental interference. He condemned attempts to regulate the industry by legislation calling for Government control. "The coal industry is entitled to a fair break and to its proper place in the business structure of the country."

E. C. Mahan,
President of National Coal Association

Regulation Opposed

Secretary Gandy in his annual report referred to consolidations and increases in tonnage of many companies in the industry. He spoke of the work of local associations in collecting and issuing trade information, which he said is having a valuable effect. He devoted considerable space to a review of attempted regulation of the coal industry and pointed out that sufficient authority now exists for fact finding, arbitration and emergency distribution of fuel. "A more friendly relationship exists with other industries and the public is trying to understand the effort which bituminous operators are making to improve the efficiency of their industry," said Mr. Gandy.

In his report as chairman of the membership committee M. L. Gould, of Indiana, predicted that the association will soon compare favorably with that of a similar organization in Great Britain which represents 98 percent of the operators and 94 percent of the tonnage.

Committees were appointed at this session, Ezra Van Horn, of Cleveland, being chairman of the resolutions committee, and S. A. Scott, of McDonald, W. Va., chairman of the nominating committee.

Mr. Frazer said a budget system would result in economies and improved operating methods for coal companies. J. E. Butler, of the Stearns Coal and Lumber Company of Kentucky, and president of the Southern Appalachian Coal Operators' Association of Knoxville, presided over the afternoon session, which was devoted to a discussion by bituminous operators' purchasing agents of problems in their field. Harold V. Coes, of the Belden Manufacturing Company of Chicago, spoke of purchasing as an executive function, and John R. Whitehead, of the Fairbanks Morse Company of Chicago, spoke on the key to profits, which he said was efficiency and care in buying policies. Those participating in informal discussion were C. F. Richardson, of the West Kentucky Coal Company, and Dr. F. C. Honnold, of the Honnold Coal Bureau of Chicago, the latter urging standardization of equipment of mines as an economy measure.

Col. W. M. Wiley, of the Boone County Coal Corporation of Sharples, W. Va., was presiding officer at the session on the morning of June 16, when reports of other committees of the association were presented and an address on management delivered by Henry S. Dennison, of the Dennison Manufacturing Company of Framingham, Mass. The report of George B. Harrington for the research committee outlined the work of the association in developing improved methods in the consumption of fuel. The

report of S. F. Love, of the publicity committee, showed how the coal industry was being "sold" to the public. In reporting for the government relations committee W. H. Cunningham said the main attack had been against legislation proposed for Government control of the industry. He declared that "economic ills of the industry can not be cured by waving the magic wand of law."

Tax Reduction

R. C. Tway, in reporting for the committee on tax and cost accounting, referred to its studies of proposed tax revision, including cooperation with the Joint Congressional Committee on Tax Revision. He said the committee is working toward a material reduction in the corporation tax at the next session of Congress.

A. J. Maloney, of the Chicago, Wilmington and Franklin Coal Company, presided over the session in the afternoon of June 16, when problems concerning bituminous sales managers and agents were considered. W. G. Magee, of the Carbon Fuel Company of Cincinnati, said sales policies are as necessary to the coal industry as nautical instruments are to the mariner. The inadvisability of a uniform date for the expiration of coal contracts was pointed out by O. M. Deyerle, president of the Flat Top Fuel Company of Bluefield, W. Va. H. E. Booth, of the M. A. Hanna Company of Cleveland, spoke of the responsibility of the salesman to his industry.

Banquet Speakers

S. L. Yerkes, of Birmingham, was toastmaster at the annual banquet, when addresses were made by the following:

R. H. Aishton, president, American Railway Association; Otis Mouser, chairman of the board, Hazelbrook Coal Company, Philadelphia, representing Anthracite Operators' Conference; B. J. Mullaney, Peoples Gas Light & Coke Company, Chicago, representing American Gas Association; Fred Legg, president, American Wholesale Coal Association; Melvin A. Traylor, president, American Bankers' Association; Wm. M. Kinney, general manager, Portland Cement Association; James S. Kemper, director, Chamber of Commerce of the United States; and Mr. Barnum.

Mine Safety

J. W. Searles, of the Pennsylvania Coal & Coke Company, presided over the meeting the morning of June 17, when P. H. Penna made his report as chairman of the safety committee. He pointed out that there are 23 organizations which are directly interested in the promotion of industrial safety. "Bituminous operators are showing special interest in this question," he said. "There has never been a time when as much effort was being put forth in the industry for the promotion of the safety of the employes. More than half of the accidents in the bituminous mines are directly attributable to the lack of care on the part of the employes and because of the widely scattered nature of mine operations it is practically impossible to eliminate such careless behavior through regulation. The 50 percent of accidents which occur at the face of the mine largely through falls of roof and coal can nearly all be eliminated by proper care on the part of the miner. Regulations imposed by the state are mechanical and inelastic and are capable of very imperfect enforcement."

Irving S. Paull, formerly of the Department of Commerce, pointed out the folly of selling goods below cost. Contrasting self-government with government regulation Mr. Paull said:

"There is a vast difference between government regulation and self-government. In the one instance you operate under routine regulations that apply to the industry as a whole; in the other you apply your initiative, energy and intelligence to the successful operation of your own business with an assurance that your contemporaries are possessed of accurate facts and motivated by ethical purposes. In the first instance, you modify competition in a considerable measure; in the second instance, you make possible the highest type of intelligent competition. Under self-government there is room for the free play of imagination and enterprise upon a basis of known facts." Ralph Knode reported for the marketing committee.

At the afternoon session, which brought the convention to a close, John A. Sargent, of the Central Coal & Coke Company of Kansas City, presided, and addresses were made by H. G. Crockett, of New York, on practical problems in operating costs; H. B. Fernald, of New York, on depreciation and capital accounts; and G. H. Nowlin, Jr., of the Killarney Smokeless Coal Company of Lynchburg, on allocation of accounts.

ESTABLISHING SAFETY RECORDS AT OLD DOMINION

(*Continued from page* 555)

operation of this committee we have also obtained some very excellent suggestions, not only for the promotion of interest but also for the elimination of hazards.

We have also found that in the safety movement strict discipline is a tremendous help, especially when it is fairly and evenly administered. We do considerable contract work underground, and we find that without strict discipline the contractors will, in many cases, take unnecessary risks in order to make a small increase in their earnings. There are also a number of men who are either antagonistic or indifferent to the safety movement and who can only be reached by fear of a lay off or discharge. I feel that increased interest on the part of the more reasonable workmen will eventually help to solve this problem, but in the meantime disciplinary methods must play an important part. This applies to the supervisory force as well as to the workmen; in fact, I feel that it is essential that the supervisory force shall be subject to penalties if discipline is to have its full effect upon the workmen.

In accident-prevention work, first-aid training is most helpful. It has been our experience that the men with thorough first-aid training not only are safer workmen but take better and more intelligent care of any injuries they receive. We have, therefore, been putting a great deal of effort into getting our men interested in first aid and have long made it a practice to send every man who receives an injury, no matter how slight, to the doctor for prompt treatment. This has very materially helped us in the reduction of infections, particularly in eye injuries.

In conclusion, I wish to emphasize that the credit for our excellent accident showing in 1926 is largely, if not entirely, due to the wholehearted cooperation of our entire organization, particularly the men in supervisory positions. The complete cooperation of the supervisory force in making safety a major operating detail is convincing the men that the company is really in earnest and not bluffing in the safety movement.

OIL AND GAS DRILLING BOND

The Interior Department has approved a form of drilling bond under oil and gas permits whereby the operating company, which has contracted with the permittee to drill the land, may furnish the $5,000 bond in connection with the drilling operations in lieu of the one usually required of the permittee. This change in practice was based upon representations that in many instances it is difficult for permittees to obtain a $5,000 bond and in other cases several permittees interested in the same permit are widely scattered, requiring considerable time and trouble to secure their signatures to the same bond. The companies who have contracted to drill the lands are interested generally in proceeding promptly and are willing to furnish the bond and become liable for the amount in event of failure to carry on operations in accordance with the terms of the permit.

NEWS OF THE MINING FIELD

A Resume Of The Activities Of The Mining Industry And Items Of Interest In The Field

Tariff Commission Orders Survey of Manganese Situation

The United States Tariff Commission has ordered under its general powers an investigation covering a study of the general manganese bearing ores in this country and abroad. The inquiry will be comprehensive in its scope, including both cost and economic studies of these ores.

In addition to its studies of the ores, the commission will also pay particular attention to concentrates and some of the products made from the manganese bearing ores. The ores are used principally in the steel industry, and are imported chiefly from Russia. The Russian importations, it was explained, are made under a concession with the Soviet Government.

The commission will be represented abroad by graduated economists and other specialists of its staff in the iron and steel industry.

Fluorspar Tariff

The Tariff Commission will hear arguments July 22 on applications for an increased duty on fluorspar.

As a basis for the hearing the commission issued a preliminary report on the costs of production of fluorspar.

The present duty on fluorspar is $5 per short ton. In 1925 this duty was on the basis of a rate of 52 percent of the declared value per ton of the imported product. Applications for increased duty were made in April, 1925, by James A. Green, of Cincinnati, and the Lundgren Stevens Co., of Chicago. Cost data and information was obtained by the commission last year covering 90 percent of the domestic output of fluorspar in 1925. Information regarding methods of operation, wages, and prices in England and Germany were secured, but cost data was not obtained from books of foreign producers. To represent foreign costs, the commission determined the value at the foreign plant by analyzing invoices of 1925 imports and the cost of shipment to American ports.

New Development at Rhyolite

Erection of a headframe and hoisting plant at the Original Bullfrog shaft near Rhyolite, Nev., has been started by the Bullfrog Mines Company. This is preparatory to sinking the shaft to a depth of 600 feet, which will be the deepest exploration work in the Rhyolite district.

Zinc Export Association Files Papers

The Zinc Export Association, Inc., New York City, has filed papers under the export trade act (Webb-Pomerene law) with the Federal Trade Commission for the purpose of exporting metallic zinc in slabs. Officers of the association are: A. J. McKay, president; B. W. Zimmer, Charles T. Orr and A. E. Bendelari, vice presidents; W. A. Ogg, treasurer; C. H. Klaustermeyer, secretary, and Ernest V. Gent, assistant secretary and assistant treasurer. Members are: The American Metal Co., Ltd., New York City; Athletic Mining & Smelting Co., Joplin, Mo.; American Zinc, Lead & Smelting Co., Chicago, Ill.; The Hegeler Zinc Co., Danville, Ill.; Matthiessen & Hegeler Zinc Co., La Salle, Ill.; The Grasselli Chemical Co., Cleveland, Ohio; Quinton Spelter Co., Joplin, Mo.; United Zinc Smelting Corp., New York City; Fort Smith Spelter Co., Greencastle, Ind., and Eagle Picher Lead Co., Chicago, Ill.

The export trade act grants exemption from the anti-trust laws to an association entered into and solely engaged in export trade, with the provision that there be no restraint of the export trade of any domestic competitor, and with the further prohibition of any agreement, understanding, conspiracy, or act which shall enhance or depress process or substantially lessen competition within the United States or otherwise restrain trade therein.

Anaconda to Build Electrolytic Zinc Plant at Anaconda

James R. Hobbins, vice president of the Anaconda Copper Mining Co. recently stated that as soon as plans and specifications now being prepared are finished the company will begin the erection of an electrolytic zinc plant of 150 tons metallic zinc per day capacity, on Smelter Hill, at Anaconda, Mont. The plant will increase the electrolytic zinc refining capacity of the company in Montana approximately 50 percent.

At present, the electrolytic zinc refinery at Great Falls has a rated capacity of 300 tons of cathode zinc per day and is producing approximately 20,000,000 lbs. of ingot zinc per month. The new Anaconda plant will be about one-half the capacity of the Great Falls plant and will produce approximately 10,000,000 lbs. of ingot zinc per month. Ores and concentrates to supply these plants will be drawn from the Butte zinc mines and from smaller Montana zinc-mining oper-

SILVER PRODUCERS SUE TO COMPEL PITTMAN SILVER PURCHASES

SUIT of mandamus has been filed in the District of Columbia Supreme Court by the American Silver Producers' Association asking the court to compel the government to buy 14,589,730 ounces of silver from domestic producers at $1 an ounce, as provided in the Pittman Act of 1918. The suit is directed against Secretary of the Treasury Mellon and Robert J. Grant, Director of the Mint.

The mandamus claims that the Secretary of the Treasury had no authority to revoke allocations of silver for subsidiary coinage as was done in the early days of the act, as such allocations were sales or resales, requiring such silver to be replaced through additional purchases.

This action of the Silver Association is expected to remove this question from further consideration by Congress. The Treasury has always urged that the matter should be settled by the Courts and not by Congress. At the last two sessions of Congress the Senate passed a bill introduced by Senator Pittman of Nevada to require the Treasury to make these purchases. The bill was also twice reported by the House Banking Committee, but never reached the voting stage in the House.

The Government's answer was due June 22, but the District Attorney for the District of Columbia, who will represent the Government, had not been able to complete the government's answer, and with the consent of attorneys for the silver producers, asked the court for an additional ten days time within which to file answer.

ations outside of the Butte district. A large part of the zinc tonnage to be treated will also come from the Salt Lake mining district, in Utah, and from the Coeur d'Alene mining district, in northern Idaho.

The new plant will cover about six acres and will require approximately 30,000 h.p.

Holds Federal Mining Can Pay Junior Dividend

The bill of complaint of H. Content & Co., against the Federal Mining & Smelting Co. has been dismissed in an opinion filed in the case by Chancellor Wolcott. The chancellor holds that the company can legally pay dividends on its common stock.

In his opinion, refusing to enjoin the company from paying a special dividend of $10 on the common stock, declared in January, 1926, Chancellor Wolcott stated that the 1926 balance sheet of the company shows an excess of assets above the amount of the outstanding preferred stock. This excess, he said, is more than equal to the amount of the $10 dividend. The fact that the 1925 balance sheet shows excess of assets in this connection, he points out, is enough in itself to warrant refusal of a permanent injunction against payment of the dividend. In refusing to enjoin the company from carrying out the policy of paying out one-half of its annual net profits remaining after all charges, except depletion, and after payment of preferred dividends, as a dividend on the common stock, the chancellor said, in his opinion, the company may very well carry out the policy without in any way injuring the rights of the preferred stockholders as safeguarded by the state corporation act. Recently the company announced it had repealed its decision to carry out the above policy affecting future dividend declarations on common stock.

California Mining Legislation

In a report on the recent session of the California Legislature, Robert I. Kerr, secretary of the California Metal and Mineral Producers Association, states that no measures detrimental to the mining industry received favorable consideration.

The legislature created a department of natural resources, with a division of mines and mining, whose chief shall be the state mineralogist. The new division will take over the former state mining bureau, state mineralogist and the department of petroleum and gas.

The ore buyers act was amended, effective July 29, to provide adequate enforcement.

A revenue and taxation investigating commission was appointed.

Upon objection of the State University no action was taken on a measure to establish a college of mining at Redding as the northern branch of the University of California, at a cost of $1,625,000.

The governor vetoed a bill giving each county the right to beneficial use of 15 percent of the waters of streams in their jurisdiction, on the ground that a commission is now considering conservation of water resources of the state.

The Assembly passed but the Senate rejected a bill appropriating $200,000 for the purchase of land and sites for dams to restrain tailings from hydraulic mining operations.

Carson Smelter Suit

Depositions of witnesses in the case of the Carson Investment Co. vs. the Phelps Dodge Corporation and the Calumet & Arizona Mining Co., for alleged infringement of patent, have been taken at Houghton, Mich. The majority of the witnesses were former employes of the Dollar Bay, Mich., smelter, where the sidewall method of feeding reverberatory furnaces is claimed to have been used before the Carson patents were taken out.

The consolidated case against the two companies has been set for trial by the Federal District Court for Arizona, at Tucson, Ariz., July 5. The claims of George C. Carson, who claims to be the originator of the side-wall feeding furnace used in smelting, have been taken over by the Carson Investment Co., of Nevada. The company won its first case, against the American Smelting & Refining Co., but lost the second case brought against the Anaconda Copper Mining Co.

The first case is now in the hands of a master appointed by the trial judge, for an accounting. The second case was appealed by the plaintiff and will come up for decision in the United States Court of Appeals at San Francisco next fall.

Suit has also been instituted by the Carson Investment Co. against several other companies in the west. These cases will be heard later.

Bunker Hill Takes Option On Quicksilver Property

Options have been taken by F. W. Bradley, of San Francisco, president of the Bunker Hill & Sullivan Mining & Concentrating Co., on the property of the United Mercury Mines Co., and the Meadow Creek gold property, owned by the same company, in the Yellow Pine district, Valley County, Idaho. It is assumed that Mr. Bradley is acting on behalf of the Bunker Hill & Sullivan Co., which for several years has been carrying on extensive developments there.

Announcement was recently made that Bunker Hill would erect a mill at the property this summer, the plans being to increase its capacity as the development of the mines justifies.

Minnesota Iron Ore Shipments Increase

There had been an increase in shipments to June 1 by the mining companies of the iron ranges of Minnesota of more than 3,100,000 tons, as compared with 1926, the totals being 9,312,557 tons for 1926, as compared with 6,122,645 for the same period in 1925.

Navigation opened earlier on the Great Lakes this year, which accounted partly for the gain in April, but in May the 1927 total was more than 1,500,000 tons greater than in the corresponding month of 1926, and the navigation probably was not responsible for the operations in that month. The higher water this year, however, has made navigation less difficult.

Minnesota Iron Ore Taxes for 1926

Occupational taxes to be paid by operators of Minnesota iron mines for the year 1926 total $2,725,312, according to Skillings' Mining Review. This is $408,880 in excess of the total for 1925, the increase being due to the larger movement of ore in 1926. The Oliver Iron Mining Company will pay about two-thirds of the total, and the independent operators the balance. The tax is based on production of 38,642,464 tons of iron ore, with a gross value of $166,769,921. After deductions allowed by law the amount upon which the 6 percent occupational tax applies was found to be $45,421,871.

Personnel Changes in Phelps Dodge Organization

P. G. Beckett, vice-president and general manager of the Phelps Dodge Corporation, has announced a number of important changes in the organization, brought about because of the resignation of G. H. Dowell as manager of the Copper Queen branch. Mr. Dowell's health made it necessary that he be relieved of the duties and responsibilities incident to the management of the Copper Queen operations. He will continue on the consulting staff of the corporation in its copper and lead metallurgical work. Captain J. P. Hodgson has been appointed manager to succeed Mr. Dowell.

Captain Hodgson came to Arizona from the Michigan copper country to become mine superintendent at the Copper Queen. Later he was made consulting engineer in the mining department for the Phelps Dodge Corporation. In 1919 he was made manager of the Morenci branch and has handled the reorganization program resulting from the purchase of the Arizona Copper Co. During this time, a very efficient caving system has been developed in the Morenci mines.

Mr. Dowell has long been identified with the Copper Queen. He was formerly manager of the Copper Queen smel-

ter at Douglas. In 1917 he became manager of the Copper Queen branch. Under his management the Sacramento Hill steam shovel operation has been initiated and brought into production, the concentrator at Warren has been built and the new lead concentrator planned and nearly completed.

Frank Ayer, who has been manager of the Moctezuma Copper Co., at Nacozari, Sonora, for the past three years, will become manager of the Morenci branch. Mr. Ayer spent many years in various capacities at Morenci before going to Nacozari and is, therefore, familiar with the Morenci operations.

H. H. Horton will be in charge of the Moctezuma Copper Co., as asssistant manager and Everard Leland, now mine superintendent at Pilares, will become general superintendent.

Phelps Dodge Leases Humboldt Concentrating Plant

Definite announcement is made that the Phelps Dodge Corporation has leased the concentrating plant of the Southwest Metals Co., at Humboldt, Ariz., which is to be remodeled and put in shape to receive custom ore. Plans are being made to commence operations about September 1.

A new lead smelter under construction at Douglas will be blown in some time in August, and the lead unit of the Phelps Dodge reduction works will then be completed.

The plan is to remodel the plant for the treatment of lead and lead-zinc ores. It will be operated as a custom plant to receive ore from the many small producing mines of the Prescott-Jerome area.

Idaho Mines Annual Report

The twenty-eighth annual report of the Mining Industry of Idaho, issued by Stewart Campbell, inspector of mines, has just been released for distribution. This report is one of the largest and most comprehensive of any that has ever been issued, containing 269 pages compactly set in small type, and 23 illustrations. It is a complete handbook on mining in Idaho and contains much information of value to those interested in mining and milling, as well as giving concise data on general mining conditions, mining companies operating in the state, and opportunities which the state offers for mineral development. As a whole it should prove of great value in displaying the mineral resources and attracting attention to the state.

The report is well illustrated with numerous views of mining scenes in various parts of the state. It is comprehensively indexed, well arranged, and its preparation has evidently involved much time and effort. It should prove an excellent medium for advertising the state's mineral resources. Copies of the report may be had upon request to the inspector's office at Boise, Idaho.

Belmont Buys Properties

Officials of the Belmont Copper Mining Co. have announced that they have completed arrangements to take over interests held by the Calumet & Arizona Mining Co. in three patented claims near Superior, Ariz., for $150,000. In addition to the purchase price the Belmont will spend $300,000 for development work. Six months ago the Belmont closed a $200,000 option on a group of 40 claims in the district owned by the Consolidated Holding & Trust Co.

TO STUDY UTAH TAX PROBLEMS

AN extensive study of Utah's tax system is to be made by a special committee consisting of A. G. Mackenzie, secretary of the Utah Chapter of the American Mining Congress, M. S. Winder, of the Utah State Farm Bureau, and O. W. Adams, of the Utah State National Bank, it has been announced by A. P. Bigelow, chairman of the Utah Taxpayers' Associations.

These three men, representing mining, banking and agriculture of the general committee of the association, will direct their efforts to determining results of the present tax system upon the equitable distribution of taxation and the manner in which the system is administered.

Sinking New Shaft at North Lily Mine

Sinking of a new four-compartment shaft at the North Lily Mine, Eureka, Utah, has been started. This shaft will serve for further development and mining of the ore body discovered some months ago and will also serve other mines of this section of the district. The new shaft is near the property line between the North Lily property and the Eureka Lily mine of the Chief Consolidated Mining Company. The North Lily mine is controlled by the International Smelting Company.

A steel headframe has been erected, compressor installed, and buildings are being erected. Plans are complete for the construction of an aerial tramway from the new shaft to the railroad at Dividend, Utah.

United States Smelting To Develop Central Standard Property

Interest in development activities in the East Tintic district, near Eureka, Utah, has been increased by the announcement that the United States Smelting, Refining & Mining Co. will develop the property of the Central Standard Consolidated Mines Co. through the Copper Leaf shaft.

In consideration of providing funds for development of this property the United States Smelting Co. has been given an option to purchase 300,000 shares of treasury stock and a substantial block of private stock. Over $300,000 has already been spent by the Central Standard in sinking two shafts and equipping the property with electrical machinery.

Predicts Miami Copper Will Be Producing Fifty Years Hence

F. W. Maclennan, general manager of the Miami Copper Co., in a recent speech at Globe made the prediction that the Miami Copper Co. would still be on a producing basis 50 years hence. He based his statement on the probable working of the 29,000,000 tons of tailings that have been produced during the last 15 years. These tailings contain copper to the value of $34,000,000, figured on the basis of 14 cents per pound. One thousand two hundred tons of ore daily are now being produced by the Miami Copper Co., carrying about 16 pounds of copper to the ton, and the ability of the company to work this low grade ore at a profit indicates in itself that the property will have a much longer life than formerly believed.

Surveys in Michigan Iron and Copper Areas

A geological and magnetic survey of areas which possibly may be underlaid by iron formations and copper bearing rocks has been started in the upper peninsula of Michigan, in charge of L. P. Barrett, state appraiser of mines and a geologist with the Michigan Geological Survey. Several parties will be sent out into the field in the iron and copper districts, each consisting of three geologists and three compass men.

The survey in the copper district will give an accurate topographical map showing the location of copper bearing rocks. The survey is linked up closely with iron and copper research work in the upper peninsula, which will be conducted by the Michigan College of Mining and Technology, and for which the state has appropriated $50,000 a year for the next two years.

Mill Improvement at Cortez Silver Mines

Reconditioning and improvement of the 100-ton mill of the Consolidated Cortez Silver Mines, south of Beawaue, Nev., has been completed. It is expected that improvements will increase the mill capacity to 125 tons per day. The installation of a grizzly and ore sorting belt should raise the grade of the mill heads, which have been running about 20 ounces silver to the ton.

Concreting Shaft at Pioneer Mine, Ely, Minn.

One of the largest shaft concreting jobs ever undertaken in Minnesota iron mines is under way at the A shaft of the Pioneer mine of the Oliver Iron Mining Company at Ely, Minn. The upper 160 feet of the shaft will be timbered. Below this the shaft will be concreted for 1,300 feet. Hoisting and pumping equipment will be completely electrified. The improvement will be completed by fall. During this period the mine will be operated through its B shaft.

Flin Flon Test Mill in Operation

A 100-ton test mill at the Flin Flon property on Athapapuskow Lake, north of The Pas, Manitoba, has been placed in operation.

The Flin Flon property was optioned to the Harry Payne Whitney interests of New York in September, 1925, and the Minerals Separation Company has been organized to take over the option for the Whitney interests. The property is reported to have 15,000,000 to 20,000,000 tons of copper-zinc ore developed by diamond drilling and underground openings. The ore body is a lens of solid sulphide containing pyrite, sphalerite, chalcopyrite and magnetite with low gold and silver values. Separation of the minerals is a major problem, and if the work in the test mill proves successful a larger mill will be built. Extension of railroad facilities to the property and construction of a power line will follow if the option is exercised.

Missouri-Kansas Zinc Corporation

Approximately $1,300,000 has been paid for four mines located in the Waco, Mo., zinc district, by the Missouri-Kansas Zinc Corporation. The properties involved were the Acme Lead & Zinc Co., Butte-Kansas Mining Co., and the Barnsdall Zinc Co. The Missouri-Kansas corporation was just recently organized. It has a capital of 125,000 shares of no-par value stock, and has issued $1,300,000 in 7 percent five-year debentures. Joseph H. Schloss, of 25 Broadway, New York City, is president of the company. L. P. Buchanan, owner of the Butte-Kansas and Acme mines, received $870,000 cash for his two properties, and the Barnsdall received $110,000 cash and stock, the value of which is reported to be more than $200,000. E. Y. Ellis, of Joplin, Mo., formerly superintendent of the Butte and Acme properties, will be resident manager for the company. C. Erb Wuensch, of New York City, is consulting engineer for the company, and is in active charge of the mines. LeRoy M. Gross, vice president of the company, had the properties involved under option the last four months.

Mexico To Govern Closing of Mines

The Department of Mines of the Mexican Government has announced in connection with the closing down of numerous mines, principally of silver and mainly in the State of Chihuahua, due to the drop in the price of silver and general economic conditions, that Mexican inspectors of mines throughout the republic will in the future decide first whether such shut-downs are justified. This is to protect mine workers. The mining industry is the largest employer of labor in Mexico.

FIELDNER MADE SUPERINTENDENT OF BUREAU OF MINES STATIONS

ARNO C. FIELDNER, superintendent of the Pittsburgh experiment station of the United States Bureau of Mines, has been appointed to the position of Chief Engineer, Division of Experiment Stations, of the Bureau, effective July 1. In his new position, Mr. Fieldner will correlate the scientific activities of the Bureau's experiment stations located at Pittsburgh, Pa.; Salt Lake City, Utah; Reno, Nev.; Berkeley, Calif.; Tucson, Ariz.; Seattle, Wash.; Bartlesville, Okla.; Rolla, Mo.; Minneapolis, Minn.; Birmingham, Ala.; and New Brunswick, N. J. At these experiment stations problems dealing with the elimination of waste in the different mineral industries are being studied.

Mr. Fieldner, who has served as superintendent of the Pittsburgh experiment station for the past six years, is rated as one of the Bureau's outstanding research specialists. He is regarded as an authority on the technology of coal, coke and gas, and ventilation problems, involving noxious gases, in mines, tunnels, and elsewhere.

Greene Cananea Copper Developing Discovery

Commenting on the important discovery of primary ore that was made on the property of the Greene Cananea Copper Co., last November, William Wraith, vice president, at the annual meeting, told stockholders that developments were proceeding satisfactorily and that the shaft, which it is planned to send down to a depth of 1,500 ft. was now down about 1,064 ft.

"The principal development work has been conducted on the sixth and seventh levels," said Mr. Wraith. "At the sixth level a development 500 ft. in length, 40 ft. wide and with a showing of better than 6 percent copper has been made, while at seventh level development 60 ft. wide has been carried on for about 220 ft. with a showing of about the same grade copper. We do not expect to strike the richest zone until the ninth levels are encountered."

The retiring directors were reelected.

Lists of Reduction Mills in Western States

A series of lists of reduction mills in the various Western States has been compiled by the Bureau of Mines. The lists cover the States of Arizona, California, Idaho, Montana, Nevada, Oregon, Utah, and Washington, and relate to operating conditions in the year 1925. The lists, which include milling plants of various types, such as amalgamation, cyanidation, flotation, and concentration plants, give data regarding the name and location of plants, the metallurgical processes employed, the character of the materials treated, equipment and power used, and the daily capacity of the plants. Copies of any or all of these lists, issued as Information Circulars, may be obtained from the United States Bureau of Mines, Department of Commerce, Washington, D. C.

PERSONAL ITEMS

G. M. Colvocoresses, General Manager of the Southwest Metals Co., Humboldt, Arizona, will make his headquarters at Phoenix, where he has purchased a home.

W. S. Boyd, for the past five years general manager of the Ray mines, has been made Vice-President of the Nevada Consolidated Copper Co., and General Manager of that company's properties in Nevada, Arizona and New Mexico, with headquarters in San Francisco.

F. H. Soderstrom has succeeded A. M. Morris as manager of the Bunker Hill mine of the Phelps Dodge Corporation at Tombstone, Arizona. Since 1923, Mr. Soderstrom has been on the Engineering Staff of the Copper Queen Branch of the corporation at Bisbee.

Alex Laist, for the past twenty years smelter superintendent for the Quincy Mining Company at Anaconda, Mont. has resigned to join his brother, Frederick Laist, General Manager of Reduction Works for the Anaconda Copper Mining Company at Anaconda, Montana.

W. A. Rose, Assistant General Manager of Mines for Pickands Mather & Co., at Duluth, Minn., has been promoted to an important post on the executive staff of the mining department of the company at Cleveland.

Donald H. McLaughlin, Professor of Mining at Harvard University, has been in San Francisco en route to the west coast of Mexico on professional work.

WAGE NEGOTIATIONS FEATURE COAL SITUATION

Pennsylvania Miners Issue Strike Order—Illinois Situation Doubtful —Non-Union Operations In Pennsylvania And West Virginia Increase

Following the failure to reach a wage agreement at the recent conference at Philadelphia between Pennsylvania operators and the United Mine Workers, the latter issued a strike order in an effort to draw out every worker—union and non-union—from the mines July 1. Officials of the Executive Board of District No. 21, United Mine Workers, expressed the hope that the walk-out of union men would be followed by the strike of the workers in the open shop operations.

The adjournment of the joint wage conference on Friday, June 24, automatically ended the temporary working agreement between operators and miners. Charles O'Neil, president of the Central Pennsylvania Bituminous Operators Association, announced then that the mines would not be open July 1. The break came after the miners refused to accept a wage cut and operators declined to sign an agreement based on the $7.50 basic wage for an eight-hour day. The miners expressed their willingness to continue working should any of the operators desire to sign separate agreements based on the Jacksonville scale.

"The day wages offered by us," said Mr. O'Neil for the operators, "is from one dollar to one dollar and a half higher than is paid in the non-union fields of West Virginia. Such a reduction would enable us to barely keep our mines open. It would affect only about 15,000 union men out of a total membership in the country of 300,000. It would help to stabilize business and prevent further industrial depression."

Illinois Negotiations

The meeting of the Coal Operators' Association of Illinois and the United Mine Workers of that state reopened on June 21, at Chicago, and adjourned on the 23d until Wednesday, June 29. While the operators were just as firm in their belief that they could not resume operations on anything but a reduced scale of wages as were the miners in their stand for a continuance of the Jacksonville scale, the situation had not reached the breaking point, and the central competitive field awaited with interest the resumption of negotiations the last of June. The negotiations in Illinois involve also wage agreements for strip mine operations and the use of loading machines in mines.

The situation confronting the Illinois coal industry is the most forbidding in history, Dr. F. C. Honnold, statistician for the Illinois coal operators, told the joint wage conference.

Dr. Honnold presented the economic status of the Illinois coal industry as of June 1, 1927, to the miners.

For three years Illinois coal has sold in the Chicago coal market for less than the average cost of production at the mines, Dr. Honnold said. Despite this fact, he declared, large volumes of coal are available from the mines of Western Kentucky at a less f. o. b. Chicago price and from numerous Eastern fields 600 to 700 miles distant at almost the same figure.

Pittsburgh Open-Shop Operations

Open shop operations in the Pittsburgh district continue to increase. The Pittsburgh Coal Company early in June put into operation its nineteenth open shop mine, the Eureka, near Smithton. This mine was started on petition of former employes.

The Pittsburgh Coal Co. is preparing its Robbeyville, Ohio, mine for resumption of operations and has secured order in United States District Court at Columbus, Ohio, restraining striking miners from interfering with operations. The United Mine Workers of America have leased six acres adjoining the mine and will establish a miners' camp.

Officials of the Washington Gas Coal Co., which operates the Tyler mine at Washington, Pa., announced that their mine would break away from the union when operations were resumed about July 1. Holmes Davis, of Pittsburgh, is president of the company.

It is understood that the Vesta Coal Co., a subsidiary of the Jones & Laughlin Steel Co., also will try to open its mines non-union about July 1. It has announced adoption of the open shop policy. The Vesta Co. gives employment to from 3,000 to 5,000 men at its large mines in the southeastern part of this county.

Island Creek Production Increases

Output of the Island Creek coal Company, taken as indicative of conditions in West Virginia continues to increase, and some expect that this company's production of coal for this year will exceed 7,500,000 tons. This will compare with 6,568,930 tons in 1926 and 6,025,715 tons in 1925. For the first five months this year production was 3,000,000 tons, and May surpassed all previous records with an output a trifle under 700,000 tons.

Tug River Operators To Join Pocahontas Association

Effective June 30, the Tug River Operators' Association will be dissolved, and most of the operators who have been affiliated with that organization are expected to join the Pocahontas Operators' Association.

The present membership of the Pocahontas Association represents an annual production of approximately 15,000,000 tons, or 86 percent of all of the commercial tonnage produced in the Pocahontas field. The Tug River field, with its 40 companies operating 56 mines, has an annual output of more than 5,000,000 tons. With the acquisition of a large percent of this latter tonnage, the membership of the Pocahontas Operators' Association will represent more than a 20,000,000 ton output annually. The organization will embrace all of the mines in Mercer and McDowell counties, W. Va., and Tazewell county, Va.

British Coal Imports Into Canada Show Large Increase

That British and other European coal is going to be a factor to be reckoned with in the eastern Canadian markets was indicated early in June by the arrival at Montreal of a shipment of 4,460 tons of German coke and 18,613 tons of British anthracite. This latter figure brings the amount of imported anthracite from British mines up to 147,274 tons since the opening of St. Lawrence navigation on April 25, as compared with 106,015 tons for the corresponding period last year. Although there was a general contraction in the coal exports from the United Kingdom last year, the importations so far this year are only about 70,000 tons less than the quantity imported for the whole eight months of navigation in 1925.

Investigation has been made by the Fuel Conservation Committee of the United States Shipping Board of the progress made in experiments with pulverized bituminous coal as a steamship fuel. The tests, which have been conducted at the Philadelphia Navy Yard, have been so successful that the final action is expected to be the installation of the apparatus on a Shipping Board steamer for trial under actual steaming conditions at sea.

Gulf States Steel Plans Improvements

Engineers are working on plans of improvement for the Gulf States Steel Co., Birmingham, Ala., on which something like $3,000,000 will be spent. Details are not yet ready for announcement, but are expected to include greater blast furnace and by-product coke works capacity, electrification of

works, rounding out steel mill, and finishing works, and improvements at the coal and iron ore mines.

To Develop Robinson Run, W. Va., Properties

Plans for the opening of a tract of more than 1,000 acres of coal land in the Robinson Run district of Monongalia County, at Maidsville, W. Va., have been announced by Stephen Arkwright, general manager of the James A. Paisley interests, marking one of the biggest coal developments in the county during the summer on the part of the Connellsville By-Product Co. Plans call for the development of the Jamison, Garlow, and Lazelle tracts of coal, and will necessitate the erection of a new tipple, the rebuilding of about a mile of tramway, and the installation of modern machinery.

Tipple Contract Awarded

The Clover Splint Coal Company, with present offices in Pittsburgh, Pa., is making rapid strides with a new development near Louellen, Harlan County, Ky. This is a new organization, headed by Howard N. Eavenson, of Pittsburgh.

The tipple will embody the most modern and up-to-date machinery obtainable for the most efficient preparation and handling of coal. In general, the equipment will comprise scales, rotary dump, various conveyors, shaking screens, picking tables, loading booms, etc.

Normal loadings will be on four tracks, viz, lump, egg, nut, and slack, with various mixers obtainable.

The contract for the machinery was recently awarded the Variety Iron & Steel Works Company, of Cleveland, Ohio, an old established firm, but newcomers with coal field equipment.

Steel Corporation's Research Laboratory

Dr. John Johnson, formerly of Yale University, has been chosen director of the recently established Department of Research and Technology of the United States Steel Corporation. Upon Dr. Johnson's recommendation, an executive council has been created for general supervision over the new department.

"We do not know ourselves how far we can go or how much we can do," Chairman E. H. Gary announced. "We think we have in our raw products, including ore, coal, stone, etc., many elements that can, by experimentation, study and analysis, be developed and utilized to the very great advantage of the Steel Corporation in its various lines of products."

River Coal Mining Resumed

River coal mining has been resumed on the Susquehanna and some of its tributaries in Northeastern Pennsylvania. More than a dozen flatboats are in operation at various points to reclaim fuel washed down the stream from the collieries. Most of the product is sold to home consumers at a price somewhat less than what is paid for other coal.

CODE ON COAL MINE DRAINAGE

The American Engineering Standards Committee on June 2, 1927, approved the recommendations of the American Mining Congress covering a tentative American standard on coal mine drainage. Their designating number is M 6—1927.

This standard is the result of seven years' continuous effort through the Mine Drainage Section of the National Standardization Division of the American Mining Congress, of which section Mr. J. A. Malady, Mechanical Engineer of the Hillman Coal and Coke Company, Pittsburgh, Pa., is chairman.

The adoption of this code in no sense lessens the activities of the section, which at the present time is actively engaged in a study of acid resisting metals.

Copies of the drainage code may be obtained upon application to the American Mining Congress, 841 Munsey Bldg., Washington. D. C.

Lake Erie-Ohio River Canal

Construction of a Lake Erie-Ohio River canal is seen as a possible means of alleviating the distress of the coal-mining industry of Ohio and western Pennsylvania by United States Senator Simeon D. Fess.

The canal project is one of the chief hopes of the Ohio coal trade, the Senator stated. He believes construction of a water route along the Beaver Valley to Lake Erie would make it possible for millions of tons of coal to be sent direct to the Northwest without regard to rail rates, which are a bone of contention between upper Ohio Valley mines and those of southern West Virginia and Kentucky. The Senator does not believe the central bituminous field would be divided over this project, because all of the states mentioned, as well as others, would benefit.

Good anthracite mined in 1850 at Stockton No. 7 colliery at Stockton, Pa., but thrown away because there was no market then for sizes smaller than egg, is to be worked by the Lehigh Valley Coal Co. The huge banks have been surveyed and their carbon contents found to run from 80 to 89 percent. A contract has been let for hauling the fuel to Hazleton shaft breaker for preparation for the market.

Assigned Car Case Decided

The right of the Interstate Commerce Commission to assign cars to bituminous mines during emergencies has been upheld by the U. S. Supreme Court, in a decision by Justice Brandeis. A dissenting opinion was rendered by Justice McReynolds. The court, in its opinion, held that Congress intended that the commission should exercise this power. The court reversed the opinion of the lower court which had decided against the commission in cases brought by the Berwind-White Coal Mining Co., Bethlehem Steel Co., and Rainey-Wood Coke Co.

In his dissenting opinion, Justice McReynolds said the matter of assigning cars to mines was for action by the management of railroads. He declared the real motive for the assigned car order was to require railroads to distribute their purchases of coal among a greater number of mines. The effect of the decision is to pro-rate all cars, whether privately owned by industries or operated by railroads.

The Supreme Court of the United States has ruled against the Independent Coal & Coke Co. and the Carbon County Land Co. in their long fight for an important tract of land in Carbon County, Utah, which was claimed by the Federal Government. The lands had been obtained from the State of Utah, but the Federal Government held that the state was not entitled to them, and that the deed transferring them to the companies in question was invalid. The decision brings to a close a legal fight of 20 years and involves 5,564 acres of coal land. The State of Utah would have received $556,428 had the sale of the land been declared legal.

The movement for the organization of the Utah Coal Operators' Association is reported to be making good headway and practically every mining company in the state is interested, although so far it has not reached the stage which requires the appointment of any officers other than the pro tem officials chosen several weeks ago. It is hoped that the new organization will have the effect of accomplishing much in the direction of developing a larger market for Utah coals, and that it will also serve to stabilize the price.

The Columbia Steel Corporation has let a contract to the Koppers Co. for the construction of 23 additional coke ovens at its plant at Ironton, Utah, involving an outlay of about a million dollars. The new installations will bring the production of coke up to 850 tons a day, which will require about 1,700 tons of coal a day. The coal will come from the steel company's mine in Carbon County.

MINING INDUSTRY STAGES BIG SAFETY CONTEST

WINNERS of the National Safety Competition, in which more than 250 mines and quarries in 30 states participated in 1926, have been announced by the United States Bureau of Mines. The winning mines and quarries in this nation-wide industrial safety contest, held annually under the auspices of the Bureau of Mines, are presented with the bronze trophy "Sentinels of Safety," donated by the Explosives Engineer magazine.

The winner in the anthracite group is the Highland No. 6 mine, Jeddo, Luzerne County, Pa., operated by the Jeddo-Highland Coal Co. In this group honorable mention was accorded the Highland No. 2 anthracite mine and the Jeddo No. 7 mine, of the same company, and also located at Jeddo; to the Upper Lehigh anthracite mine, Upper Lehigh, Pa., operated by the Hazle Brook Coal Co.; and to the Pine Hill mine, Minersville, Pa., operated by the Pine Hill Coal Co.

In the bituminous coal mining group, the trophy was won by the No. 6 coal mine of the United States Coal and Coke Co. at Gary, MacDowell county, W. Va. Honorable mention was given to four other mines operated by this company, viz: No. 8 and No. 7 mines, at Elbert, W. Va., and No. 5 and No. 4 mines, at Thorpe, W. Va.

In the underground metal mining group, the Muncie zinc and lead mine, operated by the Federal Mining and Smelting Co., at Baxter Springs, Cherokee county, Kansas, was adjudged the winner. Honorable mention was accorded the Velten zinc mine of the Eagle-Picher Lead Co., at Pierce City, Mo.; the Wilbur zinc and lead mine of the Commerce Mining and Royalty Co., at Treece, Kansas; the Armour No. 2 iron mine of the Inland Steel Co., at Crosby, Minn.; and the Lucky Bill lead and zinc mine of the Federal Mining and Smelting Co., at Cardin, Okla.

In the group of underground mines producing non-metallic minerals, the trophy was awarded to the Grand Rapids gypsum mine of the Beaver Products Co., Inc., at Grand Rapids, Mich. Honorable mention was given the Ft. Dodge gypsum mine of the United States Gypsum Co., at Ft. Dodge, Iowa; the Manheim No. 5 cement rock mine of the Alpha Portland Cement Co., at Manheim, W. Va.; the Crystal City sand mine of the Pittsburgh Plate Glass Co., at Crystal City, Mo., and the Templeton limestone mine of the Templeton Limestone Co., at Templeton, Pa.

In the quarry and open pit mine group, the trophy was awarded to the No. 5 and 6 limestone quarry of the North American Cement Corporation, at Martinsburg, W. Va. Honorable mention was accorded thirteen quarries.

Notable accomplishments in the production of large mineral tonnages with no loss of time occasioned by accidents were revealed by the detailed statistical reports furnished the Bureau by the competing companies. A zinc and lead mine in Kansas operated 300 days and worked 206,489 man-hours without an accident involving loss of an employe's time. A Missouri zinc mine and 14 large quarries, located in West Virginia, Pennsylvania, Alabama, Indiana, Ohio, Kansas, California, Virginia, and Michigan, also operated through the year with no loss of time due to personal injuries. The competition was one of the largest industrial safety contests ever held, and involved the tabulation of all accidents occurring during the course of 95,000,000 man-hours of labor. It required the preparation of accident statistic reports on a uniform, detailed basis which allows a more exhaustive study of the causes of accidents than has heretofore been possible. An encouraging feature of the competition was a substantial reduction in the accident rates of the winning companies in 1926, as compared with the previous years' contest.

Secretary Hoover, of the Department of Commerce, in addressing congratulatory letters to the winning mines and quarries, emphasized the importance of the American mining industry attaining world leadership in accident prevention as it has already attained such leadership in the production of mineral tonnages.

The more than 250 mines and quarries participating in the competition were divided into five groups; anthracite mines, bituminous coal mines, metal mines, mines producing non-metallic minerals, and quarries or open pit mines. A replica of the trophy is awarded to the mining operation in each group sustaining the smallest loss of time from accidents in proportion to total time worked during the year. Determination of the winners was made by a jury of award comprised of officials of various mining and quarrying associations, the National Safety Council, and the American Federation of Labor, based on a tabulation of mine accident data prepared by the Bureau of Mines. A feature of the competition is the awarding of a certificate of honor, signed by the Director of the Bureau of Mines, to every employe of each of the winning mines and quarries for their share in the low accident records made by their companies.

Companies operating a coal mine employing 50 or more men underground, a metal or other mine employing 50 or more men underground, or a quarry or open pit mine employing 25 or more men in the pit were eligible to compete for the trophies. The trophy, which is the work of Begni del Piatta, designer of the Navy and Marine Memorial to be erected in Washington, portrays in bronze a mother and child greeting the father upon his safe return from work. The names of the mines and quarries who win the right to hold the trophy for a year will be engraved on the pedestal. On the remaining sides of the pedestal are panels emblematic of coal mining, metal mining, and quarrying and open-pit mining.

Members of the jury of award were as follows:

H. Foster Bain, secretary, American Institute of Mining and Metallurgical Engineers, New York.

James F. Callbreath, secretary, American Mining Congress, Washington, D. C.

W. H. Cameron, managing director, National Safety Council, Chicago, Ill.

H. L. Gandy, secretary, National Coal Association, Washington, D. C.

A. T. Goldbeck, director, engineering bureau, National Crushed Stone Association, Washington, D. C.

William Green, president, American Federation of Labor, Washington, D. C.

A. J. R. Curtis, assistant to general manager, Portland Cement Association, Chicago, Ill.

METALLURGY OF MANGANESE

Pyrometallurgy is now the only practical method in vogue for extracting metallic manganese from its ores, says the Bureau of Mines, in Information Circular 6034. As manganese is highly volatile at the temperature required to reduce it to the metallic state, smelting losses are extremely high, and materially increase the cost of the reduced metal. To produce metallic manganese, the ore must be smelted at a high temperature and a strong reducing action maintained. As this method reduces any iron in the ore, the resultant metal is an alloy of manganese and iron. The Goldschmidt process, which is based upon thermit action, is now used to produce metallic manganese. In it pure manganomanganic oxide mixed with aluminum is used. The powdered aluminum is incorporated with the oxide and the mixture is brought to the required temperature. The amount of aluminum used is based on the total oxygen content of the purified manganese oxide, and is sufficient to produce sesquioxide of aluminum. Other processes for the manufacture of metallic manganese are the J. T. Jones and the Sternberg & Deutsch.

"OLD TIMERS' DAY" AT ROCK SPRINGS, WYO.

THE activity of The Union Pacific Coal Co., in Southern Wyoming, reaches back over the span of years to 1868, when the railroad, the first transcontinental line, began operation to the West Coast. Mines were opened at Rock Springs and at Carbon, 160 miles to the East. The occurrence of coal beds was a governing feature in the location of the railroad through the rather forbidding desert country which one witnesses in a trip over the Union Pacific Railroad through Wyoming. The presence of coal first became known through the report of the brave explorer, Captain Fremont, and this discovery after the entrance of the railroad resulted in the starting up of mine operations.

The early labor was chiefly British and Chinese; the Chinese having been

brought on when the construction work on the Central Pacific ended with the driving of the golden spike at Promentory Point, Utah. As the years passed the British and Chinese labor was supplemented by Italian, Salvic and many other nationalities, until at the present time there are many men of the various races and nationalities who have seen long service.

In appreciation of the life work, devotion, and sacrifice on the part of these men, Eugene McAuliffe, president of The Union Pacific Coal Co., early in 1925 arranged that the second Saturday in June, of each year, be set aside and devoted to the honoring and entertaining of all men and women who had completed a span of 20 years of service in and around the Wyoming mines.

In 1925, the "Old Timers' Day" was an agreeable and touching experience for the entire personnel. As a feature of the 1926 entertainment, an historical pageant was developed and presented setting forth the spirit of adventure, immediately subsequent to the war between the states, which led to the winning of the West. By music, dances and tableaus the story of the development of coal mining was carried on and up to a prophecy of hope for the future. A future in which the slaving toil of the past would have no place; the men of the mines becoming masters of mechanical devices which would respond to their touch in the work of bringing out the coal for the use of the railroad.

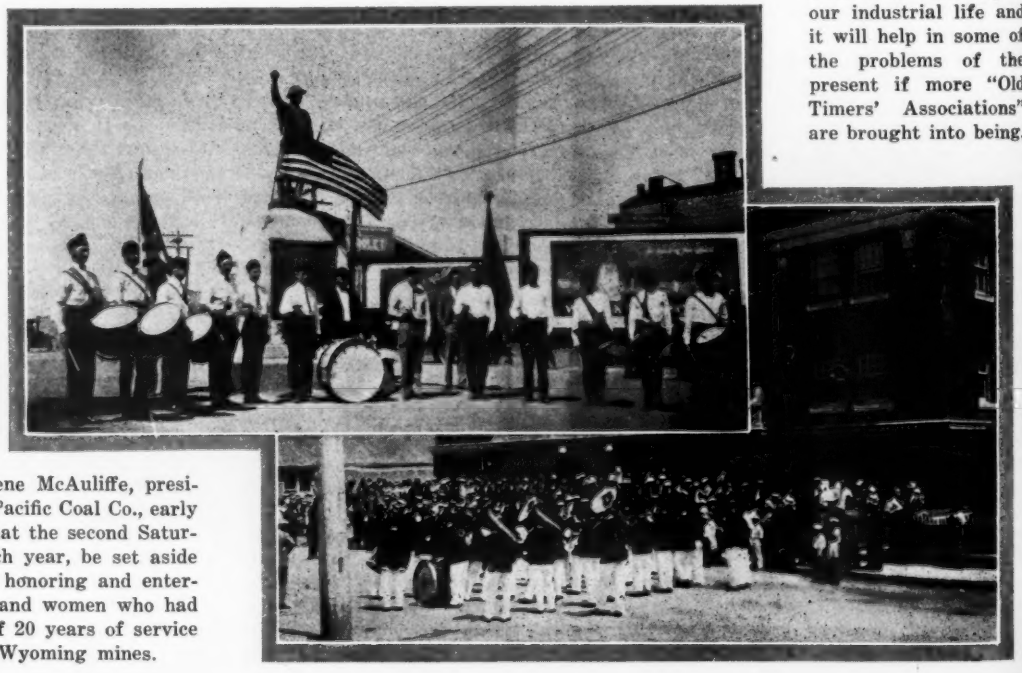
On "Old Timers' Day" this year, Saturday, June 11, 1927, the people from the six mining fields who had been gathering for two days swarmed the little headquarters town of Rock Springs. As the morning progressed registration was carried forward and the business meeting held on schedule. At 11.00 the "Old Timers" elected their officers for the ensuing year. In the meantime three excellent bands from the mining fields tendered their service for the occasion made lively music amid the town decorations and the milling throng and the merchants and towns folk gave evidence of their enjoyment of the happy day.

The showy parade led by the Senior band from Cumberland, Wyo., and in which all bands took part featured the noon hour. The three pipers to the "Old Timers," in full Scot regalia, blew grandly during the progress of the march. The "Old Timers" entered the parade by classes, the 40 plus men leading and the others following by five-year stages down to the 20-year men.

At 1.00 in the afternoon 700 "Old Timers" and their guests met in a large banquet hall and with good music, community singing and snappy speeches occupied themselves until 3.30. In the banquet hall the new class of 40-year men were each decorated with the white center gold button of the Association by Mrs. Eugene McAuliffe, of Omaha. A joint band concert in which 300 musicians participated occupied the afternoon until 5.00 o'clock when tea was served for the ladies.

The day closed with evening entertainment in the town's large and excellent theater. Picture slides of "Old Timers" in their various ages from swaddling clothes to the present time met with much applause. The movie films of previous "Old Timers' Days" provided additional entertainment subsequent to which event a professional troop of entertainers gave the "Old Timers" an unusual treat.

The entire day gave opportunity for an observer to see and feel the remarkable spirit of pleasure which may be developed through the medium of an "Old Timers' Association." The appreciation of tradition has unfathomed possibilities in the bettering of our industrial life and it will help in some of the problems of the present if more "Old Timers' Associations" are brought into being.



MEETING OF NEW MEXICO CHAPTER

A MEETING of the New Mexico Chapter of the American Mining Congress was held at the New Mexico School of Mines, Socorro, on May 19. At the open meeting in the afternoon Mr. P. H. Argall, manager of the Ozark Smelting & Mining Company of Magdalena, New Mexico, presided. The visitors were welcomed by President E. H. Wells of the School of Mines, and the response was given by Mr. John M. Sully, general manger of the Chino Mines of the Nevada Consolidated Copper Company and governor of the New Mexico Chapter.

Professor Phillip S. Donnell of the State University of New Mexico gave an excellent talk on the Middle Rio Grande Conservancy District. A comprehensive plan is being prepared looking towards the irrigation and drainage of approximately 140,000 acres of land in the Rio Grande Valley in Socorro, Valencia, Bernalillo and Sandoval Counties, New Mexico. A large part of this area is waterlogged and practically valueless under present conditions. Considerable attention is being given to flood control whereby the flood menace to city property and railroad land, as well as to farming land, may be eliminated.

The meeting was next addressed by President E. H. Wells who had for his subject "The Geology of Some of the Recently Developed Mineral Resources of New Mexico". At the Pecos mines of the American Metal Company of New Mexico, located about twenty miles east of Santa Fe, the ore deposits occur in pre-Cambrian rocks consisting of schist, gneiss, granite and diorite. Two large tabular ore bodies have been developed by underground workings and diamond drilling. They trend northeast, are nearly vertical and are arranged in echelon. The ore is a high-temperature and intermediate-temperature replacement of the pre-Cambrian rocks. The ore bodies do not extend into the overlying Pennsylvania limestones, and apparently the mineralization is pre-Cambrian. The chief ore minerals are sphalerite, galena and chalcopyrite, Other minerals which replaced the pre-Cambrian rocks during mineralization are pyrite, quartz, tourmaline, actinolite and biotite. Zinc is the chief metal, but lead, copper, gold and silver are also present in commercial amounts. The ore is treated at a 600-ton concentrating mill to which the ore is transported over a twelve-mile aerial tramway.

At the property of the Molybdenum Corporation of America in the Red River mining district near Questa, Taos County, important deposits of molybdenum ores occur. The country rock is Tertiary granodiorite, which was intruded into the pre-Cambrian complex as a large irregular stock. The ore and gangue minerals were deposited from hot ascending magmatic waters in fractures and as a replacement of the granodiorite. Molybdenite, MoS, is the chief ore mineral, but near the surface the molybdenum is present chiefly as molybdite, MoO_3, and as a hydrousferric molybdate. In places molybdenite appears in the outcrops. Gangue minerals are quartz, fluorite, brown mica and pyrite. The veins are narrow, but the ore as mined carries 5 percent or more of molybdenum sulphide. The ore is concentrated by flotation in a small mill on Red River. The concentrates carry from 72 percent to 77 percent of molybdenum sulphide, and the recovery percentage is about 85. Total production to date is 1,900,000 pounds of molybdenum sulphide.

President Wells also described briefly the great Permian salt and potash deposits of southeastern New Mexico. Information regarding these deposits has been obtained entirely from samples taken from wells drilled for oil and from diamond drill cores. According to the Department of the Interior, potash beds in New Mexico have been discovered "thick enough, rich enough, and near enough the surface to be mined, if the extent of the beds and conditions affecting the marketing of potash are sufficiently favorable." The potash-bearing beds are interstratified with salt, anhydrite and gypsum. Polyhalite is the most abundant potash mineral and the one with probably the greatest commercial interest. It is a hydrous sulphate of potassium, magnesium and calcium.

An instructive and interesting talk was given by Mr. John M. Sully on a reinforced concentrate flume under construction by the Chino Mines of the Nevada Consolidated Copper Company at Santa Rita, New Mexico. This flume will carry the waters of Santa Rita Creek around the ore pits and will make possible the mining of millions of tons of steam-shovel ore beneath the old creek bed.

A resume of the law passed by the 1927 legislature which created the New Mexico Bureau of Mines and Mineral Resources, was given by President Wells, who will also act as director of the bureau. The law provides that the bureau shall be a department of the New Mexico School of Mines and shall be under the direction of the Board of Regents of the school. The meeting closed with a discussion of the purposes and future of the Bureau of Mines and Mineral Resources.

In the evening a banquet was given at the Val Verde Hotel by the New Mexico Chapter at which the board of regents, faculty, and seniors of the School of Mines were guests. It was followed by a smoker at the School of Mines staged by the students in honor of the visiting mining men.

Underground Loading Devices in Metal Mines

A bulletin dealing with mechanical underground loading devices in metal mines, recently issued by the Missouri School of Mines and Metallurgy, in its cooperative work with the United States Bureau of Mines, has already gone into every State in the Union and to 28 foreign countries, indicating the great amount of interest in this subject.

The tremendously increased demand for the base metals, iron, copper, lead, and zinc, and the rapid exhaustion of rich, high-grade deposits of these metals that have been so important in the industrial progress of the United States, have led to constant widening of the definition of ore and to an ever-increasing scope of operations. It was to aid in this expansion that this study of underground loading was undertaken. It is a well-known fact in mining circles that the handling of the ore is one of the strong limiting factors in production. Until very recently it was estimated by engineers that 90 percent of all the minerals produced from the ground in the process of production was handled at least once by hand methods, the hardest kind of manual labor.

The studies, which were conducted by Charles E. Van Barneveld, of the Bureau of Mines, included the lead mines of southeast Missouri, the zinc mines of the Joplin district, mines in the copper and the iron districts, and other mining operations in various parts of the country. The conclusions were that while mechanical loading is not feasible in all mines, it will, where applicable, produce a substantial saving in operation costs over the old hand-loading methods and will also give other desirable results.

Where accurate and detailed costs have been kept of successful operations, they show the effect of proper and timely mechanization. The tonnage-per-man curve shoots up and the cost curve drops sharply. The net result of this as affecting labor is not, as labor at first feared, a reduction in the number of men employed, but rather a widening of the definition of ore, the inclusion of material hitherto unprofitable, expansion of operations, and the consequent hiring of more men at better pay. At a number of mines where mechanical loading has been successfully applied to local conditions, the really vital benefit has been not so much in speeding up the operation and the reduction of the unit cost, important as that is, but rather in the fact that mechanization makes the job more desirable, attracts a better grade of labor, reduces both the personnel and the labor turnover, and yields a tonnage which, under present labor conditions, could not be produced by hand shoveling.

THE IRON INDUSTRY IN 1926

IN magnitude of production in 1926 the iron and steel industry recorded a remarkable year, according to the United States Bureau of Mines, Department of Commerce. The production of steel in 1926 was the largest ever recorded and the production of pig iron was only 2 percent less than the record year. The production of iron ore, however, did not keep pace with the outputs of steel and pig iron, it showing a decrease of about 10 percent from the year of largest output.

Iron Ore

The iron ore mined in 1926 amounted to 67,623,000 gross tons, an increase of 9 percent as compared with 1925. The shipments of iron ore in 1926 amounted to 69,292,832 gross tons, valued at $174,015,645, an increase of 8 percent in both quantity and total value as compared with 1925. The average value per ton of iron ore at the mines in 1926 was $2.51, which is virtually the same as the average for 1925. The stocks of iron ore at the mines at the end of 1926 amounted to 9,495,880 gross tons, compared with 10,795,630 tons at the end of 1925, a decrease of 12 percent.

IRON ORE MINED IN THE UNITED STATES, 1925-1926, IN GROSS TONS (Exclusive of ore containing 5 percent or more of manganese.)

State	1925	1926	Percentage of increase or decrease in 1926
Alabama	7,093,250	6,847,789	— 3
California	352	282	— 20
Colorado	8,642	35,535	+311
Georgia	78,835	51,642	— 34
Michigan	14,490,529	15,248,254	+ 5
Minnesota	36,856,244	40,701,613	+ 10
Missouri	40,043	124,371	+211
Montana	3,672	724	— 80
New Jersey	202,942	209,117	+ 3
New Mexico	172,959	216,269	+ 25
New York	141,534	638,849	+351
North Carolina	22,011	15,198	— 31
Ohio	2,410	.....	—100
Pennsylvania	955,955	1,095,505	+ 15
Tennessee	164,717	138,819	— 16
Utah	270,029	295,009	+ 9
Virginia	96,272	49,159	— 49
Washington	830	1,702	+105
Wisconsin	817,149	1,322,776	+ 62
Wyoming	489,622	630,387	+ 29
	61,907,997	67,623,000	+ 9

Pig Iron

The production of pig iron in 1926, exclusive of ferro-alloys, was 38,755,698 gross tons, compared with 36,124,678 tons in 1925. In the production of pig iron in 1926 there were used 65,922,601 gross tons of domestic iron ore and manganiferous iron ore; 2,442,631 tons of foreign iron ore and manganiferous iron ore; and 6,254,523 tons of cinder, scale, and scrap, a total of 74,619,755 tons. An average of 1.925 gross tons of metalliferous materials was consumed per ton of pig iron made in 1926, as compared with 1.924 tons in 1925.

The shipments of pig iron from blast furnaces in 1926, amounting to 38,181,053 gross tons, valued at $749,633,468, showed an increase of 3.7 percent in quantity and 1.4 percent in total value. The general average value of pig iron of all grades at the furnaces in 1926 was $19.63, a decrease of 45 cents from the value in 1925.

IRON ORE MINED IN THE UNITED STATES, BY MINING DISTRICTS AND VARIETIES, 1925-26, IN GROSS TONS

(Exclusive of ore containing 5 percent or more of manganese)

District	Hematite	Brown Ore	Magnetite	Carbonate	Total	Percentage of increase or decrease in 1926
1925						
Lake Superior*	52,056,663	.....	.....	.....	52,056,663	....
Birmingham	6,312,207	323,599	.....	.....	6,635,806	....
Chattanooga	259,843	96,877	.....	.....	356,720	....
Adirondack, Northern New Jersey and Southeastern New York	.....	.....	328,745	.....	328,745	....
Other districts	†917,977	†464,124	1,143,259	4,703	2,530,063	....
	†59,546,690	†884,600	1,472,004	4,703	61,907,997	....
1926						
Lake Superior*	57,143,407	.....	.....	.....	57,143,407	+ 10
Birmingham	6,114,917	393,300	.....	.....	6,508,217	— 2
Chattanooga	198,574	68,550	.....	.....	267,124	— 25
Adirondack, Northern New Jersey and Southeastern New York	.....	.....	‡847,966	.....	‡847,966	+158
Other districts	†‡1,177,675	†349,074	1,327,322	2,215	‡2,856,286	+ 9
	†‡64,634,573	†810,924	‡2,175,288	2,215	67,623,000	+ 9

* Includes only those mines in Wisconsin which are in the true Lake Superior district.
† Some hematite included with brown ore.
‡ Some hematite from "other districts" included with magnetite from Adirondack district.

IRON ORE SHIPPED FROM MINES IN THE UNITED STATES, 1925-26, BY STATES

(Exclusive of ore containing 5 percent or more of manganese and of ore sold for paint)

State	1925 Gross tons	1925 Value	1926 Gross tons	1926 Value	Percentage of increase or decrease Quantity	Value
Alabama	6,891,081	$14,134,677	6,871,412	$13,846,656	— 0.3	— 2
California	352	*	282	*	— 20	.....
Colorado	8,642	*	35,535	*	+311	.....
Georgia	79,488	231,688	51,642	149,198	— 35	— 36
Michigan	15,254,003	40,926,315	16,699,984	43,932,982	+ 9	+ 7
Minnesota	38,022,237	96,083,485	40,961,361	103,715,621	+ 8	+ 8
Missouri	40,043	*	124,371	532,536	+211	.....
Montana	3,672	10,244	724	1,810	— 80	— 82
New Jersey	164,523	678,021	212,152	925,403	+ 29	+ 36
New Mexico	172,959	*	216,269	*	+ 25	.....
New York	413,517	1,988,735	659,741	3,015,586	+ 60	+ 52
North Carolina	22,011	49,511	14,798	31,645	— 33	— 36
Ohio	2,410	*	.....	.....	—100	—100
Pennsylvania	917,255	2,149,800	1,088,634	2,483,056	+ 19	+ 16
Tennessee	164,073	369,144	138,307	312,109	— 16	— 15
Utah	268,529	361,251	296,943	411,611	+ 11	+ 14
Virginia	76,302	174,454	49,703	162,446	— 35	— 7
Washington	830	*	1,702	*	+105	.....
Wisconsin	933,214	2,260,388	1,238,885	3,178,156	+ 33	+ 41
Wyoming	489,622	*	630,387	*	+ 29	.....
Undistributed	.....	†1,379,178	.....	†1,316,880	.....	.....
	63,924,763	160,796,886	69,292,832	174,015,645	+ 8	+ 8

* Included under "Undistributed." † This figure includes value for states entered at "*" above.

PIG IRON SHIPPED FROM BLAST FURNACES IN THE UNITED STATES, 1925-26, BY STATES

State	1925 Gross tons	1925 Value	1926 Gross tons	1926 Value	Percentage of increase or decrease Quantity	Value
Alabama	2,910,370	$57,777,275	2,875,534	$58,119,260	— 1.2	+ 0.6
Colorado	*	*	*	*	.....	.....
Illinois	3,600,484	74,937,781	3,626,330	73,460,892	+ .7	— 2.0
Indiana	3,350,747	64,807,575	3,670,478	69,292,329	+ 9.5	+ 6.9
Kentucky	153,935	*	148,053	*	— 3.8	.....
Maryland	693,523	*	791,637	*	+ 14.1	.....
Massachusetts	.....	.....	23,130	*	.....	.....
Michigan	831,435	18,452,346	638,282	13,180,113	— 23.2	— 28.6
Minnesota	276,240	*	292,658	*	+ 5.9	.....
Missouri	3,758	*	.....	.....	—100.0	—100.0
New Jersey	*	*	*	*	.....	.....
New York	2,151,036	40,435,443	2,389,665	44,970,196	+ 11.1	+ 11.2
Ohio	8,857,615	173,418,068	9,177,127	176,433,401	+ 3.6	+ 1.7
Pennsylvania	12,537,809	258,140,674	13,142,528	263,238,184	+ 4.8	+ 2.0
Tennessee	95,186	2,014,176	113,029	2,544,825	+ 18.7	+ 26.3
Utah	126,746	*	*	*	.....	.....
Virginia	97,884	2,237,749	105,019	2,322,451	+ 7.3	+ 3.8
West Virginia	499,047	9,416,095	364,302	*	— 27.0	.....
Wisconsin	226,712	4,836,952	235,597	5,034,012	+ 3.9	+ 4.1
Undistributed	†402,175	†32,842,199	†587,684	†41,038,305	.....	.....
	36,814,702	739,316,333	38,181,053	749,633,468	+ 3.7	+ 1.4

* Included under "Undistributed." † Includes figures for states entered as "*" above.

Ferro-Alloys

The shipments of ferro-alloys of all classes in 1926 amounted to 689,258 gross tons, valued at $61,368,407, an increase of 12 percent in quantity and of 16 percent in total value. The production of ferro-alloys in 1926 was 674,389 gross tons, as compared with 575,455 tons in 1925, an increase of 17 percent.

The production of ferromanganese in 1926 was 318,052 gross tons, averaging 79.25 percent of manganese, and containing 252,066 tons of manganese (metal). In the production of ferromanganese in 1926 there were used 619,898 gross tons of foreign manganese ore, 36,309 tons of domestic manganese ore, 488 tons of domestic manganiferous iron ore, 7,576 tons of iron ore, and 5,122 tons of cinder, scale, and scrap. The quantity of manganese ore used per ton of ferromanganese made in 1926 was 2.063 gross tons, in 1925 it was 2.133 tons, and in 1924 it was 2.186 tons. Of the foreign manganese ore used in 1926, Russia supplied 282,954 gross tons; Brazil, 237,358 tons; Africa, 42,692 tons; India, 31,667 tons; and the remainder was from Cuba, Chile, and Porto Rico. The quantity of domestic manganese ore used in the manufacture of ferromanganese in 1926 represented only 5.5 percent of the total manganese ore used.

The production of ferromolybdenum and calcium-molybdenum compounds in 1926 was 1,248 gross tons, containing 1,010,849 pounds of molybdenum (metal). The ferro-molybdenum averaged 58.43 percent and the calcium-molybdenum compounds 34.54 percent.

The production of ferrotungsten in 1926 was 1,808 gross tons, averaging 77.09 percent of tungsten, and containing 3,121,928 pounds of tungsten (metal).

The production of ferrovanadium in 1926 was 1,962 gross tons, averaging 36.15 percent of vanadium, and containing 1,588,591 pounds of vanadium (metal).

FERRO-ALLOYS SHIPPED FROM FURNACES IN THE UNITED STATES, 1925-26

Variety of alloy	1925 Gross tons	1925 Value	1926 Gross tons	1926 Value
Ferromanganese	254,005	$26,006,439	330,070	$31,711,871
Silico-manganese and silico-spiegeleisen			2,183	354,364
Spiegeleisen	95,890	2,407,226	82,982	2,016,088
Ferrosilicon (7 percent or more silicon)	221,387	11,405,060	233,428	12,119,465
Ferromolybdenum and calcium-molybdenum compounds	210	236,957	1,096	1,051,881
Ferrotungsten	1,238	1,991,123	1,771	2,900,053
Ferrovanadium	1,841	4,843,635	1,777	4,721,903
Other varieties*	41,651	6,157,660	35,951	6,492,782
	616,222	53,048,100	689,258	61,368,407

* 1925: Ferrochromium, ferrophosphorus, ferrotitanium, ferrouranium, ferrozirconium, and zirconium-ferrosilicon; 1926: Ferrochromium, ferrophosphorus, ferrotitanium, ferrozirconium, and zirconium-ferrosilicon.

SULPHUR AND PYRITES IN 1926

THE production of sulphur in 1926 amounted to 1,890,057 long tons, compared with 1,409,262 long tons in 1925, an increase of 34 percent, according to the Bureau of Mines. The salient feature of the sulphur industry in 1926, however, was the record-breaking shipments, which totaled 2,072,687 tons, valued at approximately $37,300,000, compared with 1,858,003 tons, valued at approximately $29,000,000, in 1925, the previous record year. Production figures were second only to those of 1923 and, while still about 183,000 tons less than shipments, were closer than they had been since the closing down of the sulphur mine, Louisiana, in 1924. Over 99.9 percent of the production was made by two companies in Texas, while over 99.9 percent of the shipments was made by these companies and the company in Louisiana which is still shipping from stocks. The record shipments of sulphur and the reduced rate of exportation in 1926 indicate record-breaking domestic consumption in that year. Stocks at the mines were reduced to 2,060,000 long tons at the end of the year.

The price for sulphur was considerably higher in 1926 than in 1925. Chemical and Metallurgical Engineering quoted a range of $17 to $19 a ton f. o. b. mines, the lower price holding for the first three months of the year and the higher price for the remainder.

Exports of sulphur or brimstone from the United States totaled 576,966 tons in 1926, valued at $10,918,580, of which 159,416 tons were exported to Canada, 108,477 tons to Germany, 91,735 tons to France, 66,507 tons to Australia, 27,340 tons to the United Kingdom, and 26,618 tons to New Zealand. Exports of refined, sublimed, and flowers of sulphur totaled 12,002,105 pounds, valued at $236,146, exported mainly to Canada, Mexico, France, and Australia. In 1925 the exports of sulphur or brimstone amounted to 629,401 tons and the exports of refined, sublimed, and flowers of sulphur amounted to 6,381,791 pounds. The exports in 1926 were second only to the record exports of 1925. Imports of sulphur and sulphur ore for consumption for nine months of the year amounted to 48 long tons and imports of sulphur in other forms for nine months amounted to 160 tons.

Pyrites

The output of pyrites in 1926 was practically at the same rate as in 1925, decreasing from 170,081 long tons, valued at $650,448, in 1925 to 166,559 tons, valued at $616,668, in 1926, or a decrease of 2 percent in quantity. The quantity sold or consumed by the producing company showed a larger decrease, from 170,298 long tons in 1925 to 163,217 tons in 1926. California and Virginia produced 95 percent of the total output, and New York and Ohio supplied the remainder.

Imports of pyrites in 1926 showed an increase of 32 percent in quantity over 1925, from 276,385 tons, valued at $773,925, to 366,151 tons, valued at $856,981, and were the largest recorded since 1919. Of the total quantity imported, Spain furnished 365,103 tons and Canada the remainder.

LEAD AND ZINC PIGMENTS

Figures compiled from reports made by producers to the Bureau of Mines, show that combined sales of lead pigments in 1926 decreased 6 percent, as compared with 1925; sales of zinc oxide decreased 7 percent, and sales of zinc salts decreased 4 percent. Sales of lithophone increased 10 percent, as compared with the former high record made in 1925; exports of lithopone, which amounted to 1,941 short tons, increased 51 percent. Exports of zinc oxide amounted to 14,661 tons—a gain of 35 percent, as compared with 1925, and the largest quantity exported since 1919.

NATURAL SODIUM COMPOUNDS AND BORATES IN 1926

The production of sodium compounds, not including common salt, from natural salines and brines in this country in 1926, as indicated by sales or shipments by producers, amounted to 93,480 short tons, valued at $2,326,750, according to the Bureau of Mines. These figures show an increase of 28 percent in quantity and 11 percent in value as compared with 1925. They cover the output of sodium carbonate, sodium bicarbonate, sodium sulphate, trona, and borax.

NATIVE AND MANUFACTURED ASPHALTS IN 1926

Sales of asphalt and asphaltic materials manufactured from petroleum at refineries in the United States during 1926 amounted to 3,458,470 short tons, which is an increase over 1925 of 9 percent, according to G. R. Hopkins, of the Bureau of Mines. Of the total sales in 1926, 1,245,160 tons, or 36 percent, was reported as having been produced from domestic crude petroleum and 2,213,310 tons, or 64 percent, from foreign crude petroleum.

MANGANESE PRODUCTION DECREASES IN 1926

THE shipments of high-grade manganese ore, containing 35 percent or more of manganese, from the mines in the United States in 1926 were slightly less than half as large as similar shipments in 1925, according to the United States Bureau of Mines. The shipments in 1926 by 45 producers amounted to 46,258 long tons as compared with 98,324 long tons by 42 producers in 1925. This decrease was due to the falling off of the shipments from Montana.

The domestic production of metallurgical ore in 1926 was 26,530 tons; that of chemical ore, 19,728 tons. Montana was the largest shipper with 5,713 tons of metallurgical ore and 17,904 tons of chemical ore. The largest individual shipper of metallurgical ore was the Crescent Mine in the Olympic Mountain Region, Clallam County, Washington, from which the shipments for the year were 3,162 tons. The mine was operated by lessees and reverted to the owners in July, and thereafter to the close of the year no ore was shipped.

There was no output of high-grade ore from Leadville, Colo., during the year. Some of the producers claim they can not operate commercially under present prices. The production of Colorado during the last four years has been: 1923, 2,278 tons; 1924, 5,338 tons; 1925, 743 tons; and in 1926 no production was reported. The price of manganese during the period mentioned has been relatively constant.

There was a material decrease in the shipments of high-grade ore from Arkansas. In 1925, this state produced 3,517 tons and in 1926, 2,450 tons. During the year two properties were equipped for the production of low-grade ores, ranging from 20 to 30 percent manganese. For the first time Idaho shipped manganese ore. During the year 1926, 800 tons of metallurgical ore and 30 tons of chemical ore were shipped.

The shipments of domestic ore containing 10 to 35 percent manganese (ferruginous manganese ore) increased from 267,252 tons, valued at $915,316, in 1925 to 364,312 tons, valued at $1,179,429, in 1926. This increase is due to the larger production in Michigan, Minnesota and New Mexico. The domestic shipments of ore containing from 5 to 10 percent manganese (manganiferous iron ores) were 835,412 tons in 1926, valued at $1,934,381, as compared with 1,153,268 tons in 1925, valued at $2,799,403. This decrease may be largely attributed to the elimination of the Wisconsin production as the manganese content in the ores shipped fell below 5 percent in 1926.

MANGANESE AND MANGANIFEROUS ORE (EXCLUSIVE OF FLUXING ORE) SHIPPED FROM MINES IN THE UNITED STATES IN 1926, BY STATES, IN LONG TONS

State	Ore containing 35 percent or more of manganese			Ore containing 10 to 35 percent of manganese			Ore containing 5 to 10 percent of manganese		
	No. of shippers	Shipments	Value	No. of shippers	Shipments	Value	No. of shippers	Shipments	Value
METALLURGICAL:									
Alabama	2	896	*	5	1,018	$6,421	..	.....	.....
Arizona	2	2,684	*	1	46	*	..	.....	.....
Arkansas	4	2,450	$64,010	12	8,195	47,428	..	.....	.....
California	3	393	8,750	.	.....	.....	..	.....	.....
Colorado	..	.....	.....	2	2,925	*	..	.....	.....
Georgia	5	3,251	29,890	17	18,414	121,773	2	6,547	*
Idaho	1	800	*	2	351	*	..	.....	.....
Massachusetts	..	.....	.....	1	*	*	..	.....	.....
Michigan	..	.....	.....	2	107,202	*	..	.....	.....
Minnesota	..	.....	.....	2	158,759	*	5	799,458	$1,791,350
Montana	3	5,713	44,226	..	.....	.....	..	.....	.....
Nevada	1	1,607	*	4	12,205	58,941	..	.....	.....
New Mexico	1	1,966	*	2	52,033	*	1	29,407	*
North Carolina	1	55	*	..	.....	.....	..	.....	.....
Tennessee	2	1,555	*	1	953	*	..	.....	.....
Utah	..	.....	.....	1	*	*	..	.....	.....
Virginia	4	1,998	40,242	2	2,135	*	..	.....	.....
Washington	1	3,162	*	..	.....	.....	..	.....	.....
Undistributed	..	.....	192,775	..	76	944,866	..	.....	143,031
	30	26,530	379,893	54	364,312	1,179,429	8	835,412	1,934,381
CHEMICAL:									
Idaho	1	30	848,770	..	.....	.....	..	.....	.....
Montana	13	17,904		..	.....	.....	..	.....	.....
Virginia	1	1,794		..	.....	.....	..	.....	.....
	15	19,728	848,770	..	.....	.....	..	.....	.....

* Included under "Undistributed."

MANGANESE ORE IMPORTED INTO THE UNITED STATES, 1925-1926 *
(General imports)

	1925		1926	
	Manganese content long tons	Value	Manganese content long tons	Value
Africa (British):				
South	.....	.....	6,214	$39,683
West	31,750	$322,360	48,295	1,088,390
Brazil	109,650	2,755,876	130,698	3,428,740
Canada	1,199	49,406	200	9,841
Chile	3,434	64,608	3,942	100,478
China	245	12,000	.....	.....
Cuba	†	253,315	†	224,523
Germany	46	6,195	72	8,976
Hongkong	622	22,528	.....	.....
India (British)	23,504	550,871	30,596	899,161
Italy	.....	.....	2,920	76,263
Java and Madura	.....	.....	285	4,159
Netherlands	5	637	12	1,327
Norway	.....	.....	1,700	133,528
Russia in Europe	114,537	4,101,070	122,345	5,046,176
United Kingdom	1,572	119,788	99	9,886
	286,564‡	8,258,654	347,378‡	11,071,131

* According to the Bureau of Foreign and Domestic Commerce.
† The imports from Cuba are recorded as 12,745 tons of ore in 1925; and as 14,112 tons in 1926.
‡ Exclusive of the manganese content of Cuban ores.

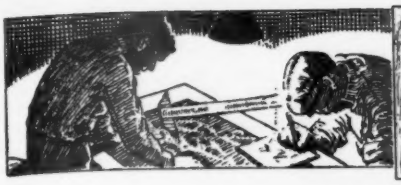
PENNSYLVANIA BRIQUETTE INDUSTRY

According to J. S. Sisler, of the Pennsylvania Geological Survey, the future of the briquette industry in that state is assured. Mr. Sisler has just completed a long study of the utilization of the fine sizes of anthracite coal, much of which for years has gone into the waste piles, and in the briquette industry sees a practical method for the utilization on a profitable basis. After pointing out in his report to the Geological Survey that two ways are open for the manufacture of briquettes—by mixing with binder and crushing, or by mixing with bituminous coal and carbonizing—Mr. Sisler summarizes his studies as follows:

"When the fine sizes of anthracite are used at a profit or at least made to pay for themselves, it relieves the pressure of mining costs on domestic sizes which should result in a reduction in price of the larger sizes. In the anthracite region there are thousands of tons of fine anthracite now stored in culm banks or going to waste into the creeks which could be used for briquetting.

"While the briquetting industry could not use a large percentage of the fines which are produced in anthracite mining, it is one method by which profits could be realized from material which the operators would like to see utilized."

The report added that four of the seven briquetting plants in America are located in Pennsylvania, Carbon, Dauphin, Schuylkill and Northumberland counties, each having one.



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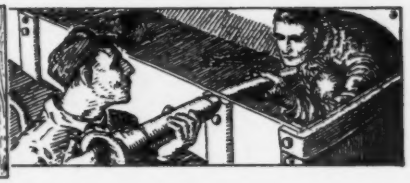


New Room Hoist Motor for Mines

A new type RH, totally enclosed motor, rated at 5 h.p., 15 minutes, 55 degrees C temperature rise, 1,150 r.p.m., compound wound, 115, 230 or 550 volts, has been developed by the Westinghouse Electric and Manufacturing Company particularly for use on portable type room hoists in mines. Many designs and operating features make it especially applicable for this kind of service. Across-the-line starting is permitted with negligible disturbance at the commutator.

The armature coils are so constructed and installed that a single coil can be replaced with a minimum disturbance of the other coils. Each coil is specially insulated and the completed armature is thoroughly impregnated and baked, giving assurance of freedom from insulating troubles. The shunt and series coils for one pole are assembled as one unit and are dipped and baked in this f.rm. Special precautions are taken to insulate the coils from each other and from ground.

The RH motor is rugged in construction, having a rolled steel frame and drop forged steel feet which are welded to the frame. The bearings are heavy duty roller type and the motor will operate in an inclined position. The enclosing covers are hinged to the bracket and can be raised for inspection of the brushes and commutator by simply loosening one screw. There are a total of four covers, giving good access to these parts.

New Portable Test Meter

A new portable meter to be used as a standard in meter testing has been introduced by the General Electric Co. The new meter, designated as Type IB-7, is made for 110-220 volts, 25 or 60 cycles, and 1/5/20 amperes. The effects of variation in voltage, frequency and power-factor are minimized to negligible values, and there is almost entire freedom from temperature errors.

The case is of cast aluminum alloy, finished in black lacquer and is provided with a black leather carrying strap. The white enamel dial is easily read against the black bakelite top. A light, rigid, aluminum alloy frame supports the entire meter element, and is firmly attached to the molded bakelite top. The base of the frame is flat, so that when the metering unit is removed from the case it stands upright on the bench, facilitating inspection or adjustments.

A Silent Coal Inspector

Five hundred dollars a month may seem like a high figure to place as the earning power of a single separator magnet, but that is the value placed on the equipment which a No. 5-SA E. C. & M. separator magnet is salvaging from the stream of coal flowing steadily beneath its face, according to a statement of the Electric Controller & Mfg. Co., Cleveland, Ohio.

They further say: "Five hundred dollars is the actual money value of the material which can be put back into service plus the scrap which is sold as scrap. Think of the additional earning power that can be credited to this separator magnet when you consider the accidents to coal crushers and pulverizers which are prevented by the removal of this iron and steel at the mine.

"A belt conveyor carries this coal from the mine to the loading dock and every pound of that coal passes under the influence of this magnet. Steel shot wire weighing only a few ounces is separated from the tons of coal with which it was tangled by the blast which it set off. Mine car hitchings, heavy steel chains which weigh many pounds, are lifted out even though they may have been buried under the full 12 inches of coal. Each week more than a keg of track spikes are accumulated. Such things as miner's goggles, a hand saw, pocketknives, miners' axes, a 4-foot piece of 25-pound steel rail, car replacers, all have been salvaged by this silent inspector.

"This 55-inch separator magnet is mounted at an angle at the head pulley where the coal is loosened in its fall from the belt. It is suspended from a double truck trolley which rides on an I-beam so, by means of a hand winch, the magnet can be quickly pulled out of position to drop the tramp iron that has collected and then run back into place.

"In the illustration showing this installation there appears to be a spacer bar extending out from the left face of the magnet. The separator has picked up a miner's axe and this is the handle showing. An interesting story told about this separator is that when a pocketknife is found the attendant saves it, knowing that because of the miner's confidence in the magnet one of them will be after his knife."

Mine Locomotive Headlights Will Withstand Severe Operating Jar

The Westinghouse Electric and Manufacturing Co. exhibited mine locomotive headlights at the American Mining Congress as one of the features of the exhibit. In an announcement they say:

"These headlights are sturdy in design to enable them to stand up under the most severe operating conditions. They are constructed with spring suspensions which will protect the lamp filaments from breakage caused by vibrations and jars.

"The Type L headlight has its lens holder fitted to the case with a threaded joint which, with rubber gaskets, tightly seals the headlight. A heavy cast iron grid protects the lens from breakage.

"The Type S headlight is of approved gas proof construction. The front cover is fitted to the case by machined threads with lead gaskets, each side of the glass front allowing an inch of actual creepage distance in all joints so that any gases ignited within the headlight will be cooled before reaching the outside. The cover has a threaded fit of fully an inch in addition to the machined flange. The lens is ½ inch thick to conform with requirements."

Westinghouse Adds New Switches to Standard Lines

New designs of switches have been added by the Westinghouse Electric and Manufacturing Co. to their standard

WK-60, WK-61, WK-62, and Midget lines. In addition to this a new range switch for flush or surface mounting has also been introduced that has many advantages for range use. These were shown at the American Mining Congress May 16-20, at Cincinnati, Ohio.

A complete set of styles including solid neutral switches of the three blade, two fuse type is the addition to the WK-60 group. The WK-62 group has been augmented by the addition of four-wire switches consisting of four blades and three fuses for use on three phase, grounded neutral systems and five wire switches with four blades, four fuses with solid neutral block for use on two phase interconnected grounded neutral systems. The new WK-61 switches consist of a 600 ampere size switch and an addition of a complete set of ratings in double throw switches, fusible at each end. N. E. C. fusible switches, solid neutral switches and special designs for small motor work have been added to the Midget and type 00 line of switches.

The new range switch is particularly designed for both flush or surface mounting, and operated by a handle in the front. This switch is compact in struction and neat in appearance. It is particularly applicable to ranges not requiring over 40 ampere, 250 volts, or 40 ampere, three wire 125 volts. The rating on type WK-22 motor starter has also been increased from 5 H. P. at 220 V. to 10 h.p.

"Pliers-Type" Current Measuring Set

A split-core current measuring set that is especially valuable in determining the load on feeders or distribution net works has been introduced by the General Electric Co. The set is intended for use in determining the alternating current flowing in a conductor without opening the conductor to insert an ammeter or a current transformer to operate the ammeter. Each set consists of a transformer with a hinged magnetic circuit, leads, and one or more ammeters. It can be used to advantage when it is not required that the accuracy be of the order that can be obtained only with self-contained ammeters or portable current transformers and ammeters.

A distinctive feature of the set is the ease with which the transformer can be clamped about the conductor. It operates like pliers—with one hand—thus insuring safety for the lineman. In the case of overhead lines the transformer can be clamped from below, thus avoiding the necessity of reaching over high-voltage lines. Flexible multi-conductor leads 50 feet in length are supplied with each set.

Two sizes of transformers are supplied, one having a window opening of 1¼ inches and the other 2¼ inches in diameter.

A New Paint Spray Unit

The Alexander Milburn Co., 1416-1428 West Baltimore Street, Baltimore, Md., has recently placed on the market a paint spray unit known as the Milburn Type E1 Siphon-feed Outfit. This unit is complete, ready to begin work. It consists of the Milburn Type E Gun with quart container, air conditioner, air regulator and 25 feet air hose with necessary connections and is built to withstand constant service. Its wide range of usefulness makes it a valuable asset to every paint department.

The April issue of the Explosives Service Bulletin, published by the E. I. du Pont de Nemours & Co., carries an article by George S. Brown, technical representative, entitled "Drilling on the Solid and Some Other Inefficient and Dangerous Practices in Blasting Coal."

New Main Haulage Locomotive Is Most Powerful Ever Built

A marked advancement in the development of electric mine locomotives for main haulage was represented by the new 20-ton Baldwin-Westinghouse locomotive recently completed for the Bertha-Consumers Company. This locomotive was demonstrated for the first time in the Westinghouse booth at the recent exhibition of the American Mining Congress in Cincinnati, prior to its shipment to Burgettstown, Pa., where it will be placed in service in Bertha Mine.

It is the most powerful locomotive of its type ever built, having a total capacity of 300 horsepower, supplied by two motors, which is unequaled in mine motor capacity for two-motored units.

The mechanical features of this titanic Baldwin-Westinghouse locomotive include barsteel side frames located outside of the wheels, and held to the end frames by driven through-bolts in reamed holes, forged steel axles, steel-tired wheels, semi-elliptic leaf springs, Timken tapered roller journal bearings for driving wheels, automatic locking screw type brake, straight air brake, four sand boxes arranged for air operation, an air whistle, and a special space provided for carrying a rerailer iron.

The principal dimensions of the locomotive are:

Track gauge, 42 in.
Wheel base, 80 in.
Width over trolley socket, 67½ in.
Width overall and over bumpers, 72 in.
Height overall, excluding trolley pole, 45 in.
Length, excluding bumping block, 17 ft. 4 in.
Wheel diameter, 36 in.

The nominal rating of the locomotive is 10,000 lbs. drawball pull at a speed of 8¾ miles an hour with the motors operating in parallel.

On level track the locomotive will be capable of starting and hauling a 400-ton train. On a 1 percent grade the locomotive will be capable of starting and hauling a 275-ton train,

This locomotive is replacing two 10-ton locomotives which have been used in the main haulage. By this substitution the company calculates that savings in power by avoiding peaks, release of other motive power and crews to other service and in other ways will pay for the investment in about two years.

Small Alternating Current Contactors

General Electric announces a small alternating-current contactor for general application, self-contained on a molded base measuring 6½ in. by 4½ in., and providing two main poles rated at 15 amperes and a normally open interlock. This device takes from 3 to 6 watts and will, therefore, operate from a 50-watt, bell-ringing transformer.

Harnischfeger Puts Out New Type of Backfiller

The Harnischfeger Corporation, Milwaukee, Wis., world's largest builders of gasoline driven excavators, announces a new, improved type of backfiller. The construction of this new model is consistent with that of their new line of all steel excavators, being also built on a foundation of unit cast steel construction. All shafting is in the same plane, thus making it a simple matter to renew any shaft or gear thereof.

The lever arrangement has been simplified to four levers instead of seven as has been the usual custom heretofore. The boom hoist and swinging is power-controlled through a worm and worm gear. The boom can be swung through 180 degrees.

Link-Belt Co. have announced the new Caldwell Speed Reducer (manufactured by their subsidiary, the H. W. Caldwell & Son Co., Chicago), which is illustrated and described in book No. 630 just off the press.

The Caldwell Speed Reducer is a self-contained unit which combines two separate drives: a Link-Belt silent chain drive from the high speed shaft, and a cut spur gear drive to the low speed shaft, made in sizes to furnish ratios from 7:1 to 40:1 in Type "A," or to 30:1 in Type "B." Type "A" is designed for general industrial uses, while type "B" is for screw conveyor service.

With the Caldwell Speed Reducer it is not necessary to use a flexible coupling on the motor shaft; the silent chain drive provides the necessary flexibility between the motor and the speed reducer shaft.

Copies of book 630 may be secured from Link-Belt Co., Chicago, Ill.

New Dynamite Plant at Birmingham

The new dynamite plant of E. I. du Pont de Nemours & Co., at Mineral Springs, a short distance from Birmingham, Ala., just completed, began actual manufacture of dynamite May 16. This is the largest dynamite plant in the South and has an annual capacity of 15,000,000 pounds. It is contained within an area of 1,280 acres and comprises some 50 separate buildings of the most modern type for this kind of manufacture and equipped with the latest machinery.

In the best constructed dynamite plants, such as this, a large area is taken up for safety purposes. The buildings in the danger area are widely separated. In the manufacture of dynamite, the minimum number of men is employed.

A complete line of dynamite and gelatin dynamites will be manufactured at the plant. These will include explosives for every kind of operation in the South, from submarine blasting to coal and metal mining, quarrying, lumbering, and agricultural uses, including ditch blasting.

From an industrial point of view, the completion of the plant is regarded as important since the progress in the South in industries using explosives has been very large during the past five years. In that space of time, the consumption of dynamite in the southeastern states has increased 100 percent. The consumption of commercial explosives is regarded as a barometer of trade since, when large quantities of these are being used, it means that mines and quarries, railroad building and other construction work are moving ahead fast.

Distributing facilities are also provided at the plant for blasting supplies and for distributing black powder from the company's plant at Connable, Ala.

Bethlehem's New Grey Mill at Lackawanna

The first electrically driven grey mill in this country, and one of the largest mills of its kind in the world, was placed in operation at the Lackawanna plant of the Bethlehem Steel Company early in April. From the standpoint of total horsepower involved, it is one of the most highly powered mills in this country.

Allis-Chalmers Buys Transformer Company

Allis-Chalmers Mfg. Co. has bought Pittsburgh Transformer Co. This will add a complete line of transformers of all voltages, sizes and types to the electrical line of the company. R. V. Bingay, president of the transformer company, will be on the directorate of Allis-Chalmers.

Broderick & Bascom Rope Co. announce removal of their office to 68-70-72 Washington Street, New York City, telephone Bowling Green 2742-2743, and invite inspection of their office and warehouse.

H. G. Peake announces the dissolution of the copartnership known as the Union Construction Company, and removal to the Alexander Building, at 155 Montgomery Street, San Francisco, Calif. The firm name is H. G. Peake Engineering Company. This firm will be engaged in the design and building of dredges for all purposes, and other engineering work.

Westinghouse Reactors

Paralleling reactors type RR for 115 volts to 575 volts, and type SR for 2,300 to 6,900 volts single phase are described in Westinghouse Leaflets 20317 and 20316 respectively. Both of these leaflets describe the design, operation and construction of these reactors, and contain tables of adjustment for different reactances. Wiring diagrams and halftone cuts complete these leaflets which may be obtained at any of the district offices of the Westinghouse Co. or from the department of publicity at East Pittsburgh.

Link-Belt Company Issue "Link-Belt Typical Elevators" Book

The Link-Belt Company, of Philadelphia, Chicago and Indianapolis, have just issued a new publication entitled "Link-Belt Typical Elevators." The book consists of 44 pages of illustrations, examples, ratings, capacities and tables showing how to select typical elevators.

For convenience in selecting elevators they are divided into classes, governed by the nature of the material to be handled.

Class C elevators are used for handling coal and other non-abrasive materials weighing approximately 50 pounds per cubic foot. The chains used are of the Ewart Detachable, or the "C" class. Where the service is light or intermittent, Ewart Detachable Link-Belt should prove satisfactory, but where the service is more continuous and severe the "C" class chains are preferable.

Class A elevators are used for handling ashes and other abrasive materials weighing about 40 pounds per cubic foot. They are usually furnished with steel casings, as this prevents abrasive dust from circulating. The chains used are of the "C" or "800" class, the former for light or intermittent service, and the latter where the service is more continuous and severe. The "800" class is particularly applicable and preferable for hard service, and where the material is very abrasive.

Class S elevators are used for handling either abrasive or non-abrasive materials weighing about 100 pounds per cubic foot. They are recommended for heavy materials and hard service.

There are two general types of Typical Elevators in common use, known as the Centrifugal Discharge and Continuous Bucket types. The information given in this book will be helpful in connection with the selection of the proper elevator.

Copies can be had by addressing the Link-Belt Company, 910 S. Michigan Avenue, Chicago.

New Catalog on Elevating and Conveying Equipment

Ways and means to solve the age-old problems of elevating and conveying are graphically depicted in a new book published by the Link-Belt Co. The title of this 96-page book, No. 575, is "Handling Things From Where They are to Where You Want Them," and it covers many types of handling equipment applied to a wide field of industrial conditions today. Copies may be obtained by requesting Link-Belt Co., Chicago, for Book No. 575.

The International Nickel Co., 67 Wall Street, New York, have recently issued a new bulletin, No. 10, on "Chrome Nickel Steel in Special Track Work."

A scientific and practical discussion of the characteristics of this new steel, which in service has demonstrated its practicability and economy for use in equipment subject to unavoidable abuse and hard wear. Results of more than six years use by Milwaukee Electric Railway and Light Co. are given.

Previous bulletins of this series, together with serviceable loose leaf type binders to facilitate filing them will be gladly furnished on request.

The Braun Corporation, manufacturers and importers of scientific laboratory supplies, Los Angeles, Calif., have issued a new illustrated catalog, No. 27, which they claim is a modern encyclopedia of laboratory equipment for chemical, industrial, metallurgical, research or educational lines. Items are arranged alphabetically throughout the book, excepting those belonging to special groups. It is printed on thin opaque paper, light in weight and easy to handle. Catalog No. 27 supersedes all former issues. Copies may be obtained from the companies' Los Angeles office.

Link-Belt Kangaroo Konveyor

The Link-Belt Co., Chicago, have published a booklet, No. 921, which describes and illustrates in detail their recently introduced "Kangaroo Konveyor," an underground coal shaking conveyor which they are now building after extensive research and experimentation with various types of conveyors under numerous conditions. The Kangaroo Konveyor gets its name from the peculiar motion imparted to the coal in the trough. In operation the coal takes a quick forward move, and when the normal number of impulses are imparted to the conveyor by the driving gear, the coal continues to flow as though it had become liquid. The trough sections are made in 9, 10 and 12-ft. lengths, and are assembled in sufficient number to make up whatever length of conveyor is required. Where joined together the pans are supported by a loose roller, guided by a roller race. A second roller race, called the chair, supports the roller and pan.

Copies of this book may be obtained upon request to the Link-Belt Co., 910 S. Michigan Avenue, Chicago, Ill.

Westinghouse Leaflet on Switchboards for Automatic Mining Substations

Leaflet 20322 has just been released by the Westinghouse Electric and Manufacturing Company, describing simplified switchboards for automatic mining substations. This leaflet goes into considerable detail as to the distinctive features of these switchboards, including protective relays, sequence of operation, protective features and other application and operation factors. A schematic diagram for simplified automatic mining switchboards and half-tone illustrations of these boards complete this leaflet. It may be obtained at any of the district offices of the Westinghouse Company or from the Advertising Department, East Pittsburgh, Pa.

Automatic Pulverizer Bulletin

Raymond Brothers Impact Pulverizer Co., Chicago, Ill., has issued a bulletin on their Raymond Automatic Pulverizers, which is fully illustrated and which contains special information on modern grinding and pulverizing with air separation.

The Fawcus Machine Company, Pittsburgh, Pa., have just issued a new catalogue, (Bulletin E), covering a new line of Fawcus Worm Gear Speed Reducers, epuipped with Timken Roller Bearing.

This catalogue is replete with typical installations and engineering data, interesting and valuable. Copies may be obtained from the company's offices at 2818 Smallwood Street, Pittsburgh.

Shafts and Shaft Sinking

The E. J. Longyear Company, Minneapolis, Minn., have recently issued a booklet entitled "Shafts and Shaft Sinking." While it includes only a few of the shaft sinking, tunneling and mine development contracts that the company has carried out, it gives some idea of the wide geographical distribution of their work and the variety of conditions encountered. Copies of this booklet (Bulletin No. 27) are available at the company's Minneapolis office, Security Building.

The Jeffrey Manufacturing Co., Columbus, Ohio, have published a new catalogue, No. 435, featuring Jeffrey Standard Apron Conveyors.

The wide range of application of Jeffrey Wood and Steel Apron Conveyors in handling both bulk and package materials have given them a place in practically every industry, as shown by illustrations in this book.

Typical layouts giving general dimensions accompanying the tables of specifications. The data shown permits of Jeffrey products being easily selected by the layman, as well as the engineer, which often means a great saving of time and expense.

The Barber-Greene, Aurora, Ill., have issued a booklet on modern outside coal handling epuipment, entitled "The Adventures of the Three Yardsmen," illustrating and describing ways to cut the costs of unloading, storing and loading coal for delivery. Copies may be obtained from the company, 444 W. Park Ave., Aurora, Ill.

Thorne, Neale & Co. announce that owing to illness Mr. Arthur S. Learoyd has felt impelled to resign his position as manager of the New York branch of this company, and his resignation has been accepted with regret.

Mr. John K. Barber has been appointed acting manager of that office.

William B. Senseman has been appointed Pacific Coast district manager for Combustion Engineering Corporation, Raymond Bros. Impact Pulverizer Co., Ladd Water Tube Boiler Co. and Heine Boiler Co., all subsidiaries of International Combustion Engineering Corporation.

Mr. Senseman has been associated with Raymond Bros. Impact Pulverizer Co. for the past 15 years and since 1917 has represented that organization on the Pacific Coast. The new consolidated offices are located in the Subway Terminal Building, 417 South Hill St., Los Angeles, Calif.

Mr. C. A. Gunther, a graduate of the University of Wisconsin Engineering Class of 1924, is now in charge of the Buffalo territory, for the Chain Belt Co., Milwaukee, Wis. He is located at the branch office, 753 Ellicott Square, Buffalo, New York, and will handle from there the sale of Rex chains, elevators and conveyors and Stearns equipment. The Stearns Conveyor line was acquired when that company at Cleveland was recently purchased by Chain Belt.

The Electric Controller & Mfg. Co., of Cleveland, Ohio, announces the appointment of the firm of Mr. J. B. McCarthy and Mr. W. P. Robinson as representatives in Canada. Their offices are at 307 Reford Bldg., Toronto, Canada, and 808 Drummond Bldg., Montreal, Quebec, Canada.

The Electric Controller & Mfg. Co. also announces the appointment of the Petroleum Electric Co., 217 East Archer Street, Tulsa, Okla., as their representative in Oklahoma and the Pan Handle District of Texas.

Mr. E. L. Parsons, formerly district manager for the Ramsey Chain Co., of Boston, has recently joined the sales force of the Foote Bros. Gear & Machine Co., and has been appointed district representative for that company for the State of Wisconsin and northern Illinois, with headquarters at 49 E. Wells Street, Milwaukee.

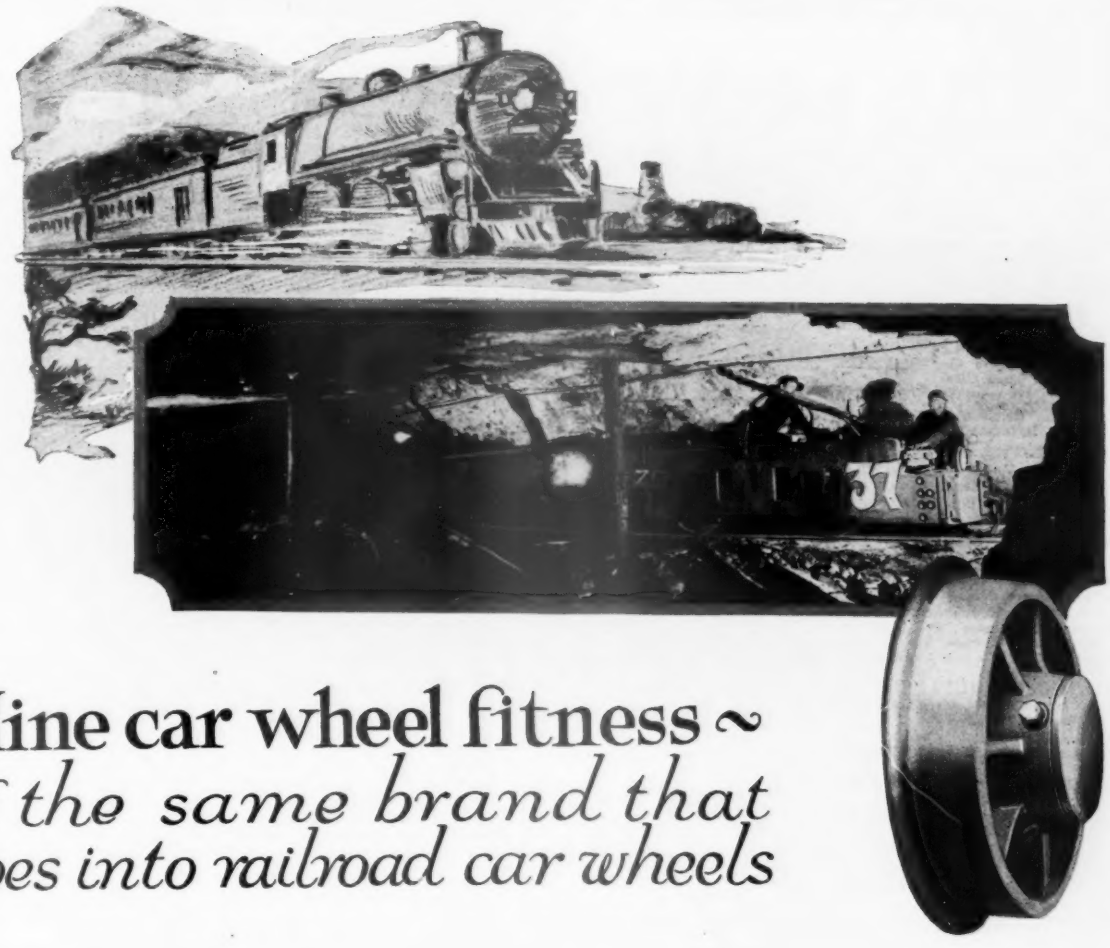
W. C. Davis, president of Foote Bros. Gear & Machine Co., and Frank P. Callaghan, vice president and chief engineer, recently made a tour of the eastern sales offices of the company for the purpose of conferring with regard to the territorial questions and sales policies for the future. On their return trip they attended the meeting of the American Gear Manufacturers' Association, at Lansing, Mich.

Trico Announces New Sales Appointments

Trico Fuse Mfg. Co., Milwaukee, Wis., manufacturers of Trico renewable fuses, announce the appointment of Mr. B. M. Slicting as sales promotion manager, who will be in charge of the sales promotion work at the company's main office in Milwaukee. Mr. J. E. Eldredge, of South Windsor, Conn., was appointed as sales representative for the State of Connecticut and western part of Massachusetts. Mr. Arthur E. Bacon, of 1429 Eighteenth St., Denver, Colo., was appointed as sales representative for the States of Colorado, New Mexico, Utah and Wyoming.

Change In Personnel

Mr. Frank J. Donnelly has joined the New York office of Botfield Refractories Co., Philadelphia, Pa., and will cover the New Jersey territory under the direction of Mr. Chas. C. Phillips, New York district manager. Mr. Donnelly will cooperate with users of their product, Adamant Fire Brick Cement, and with every refractories user interested in prolonging brickwork life and in reducing repair costs.



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ACETYLENE, Dissolved (Or in Cylinders)
Prest-O-Lite Co., Inc., 30 E. 42d St., N. Y. C.

ACETYLENE GAS
Prest-O-Lite Co., 30 East 42d St., New York City.

ACETYLENE GENERATING APPARATUS
Oxweld Acetylene Co., 30 E. 42d St., New York City.

ACID, SULPHURIC
Irvington Smelting & Refining Works, Irvington, N. J.

AERIAL TRAMWAYS
American Steel & Wire Co., Chicago and New York.
A. Leschen & Sons Rope Co., St. Louis, Mo.

AFTERCOOLERS (Air)
Ingersoll-Rand Co., New York City.

AIR COMPRESSORS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City.

AIR HOSE COUPLINGS
Knox Mfg. Co., 811-821 Cherry St., Philadelphia, Pa.

AIR LIFT PUMPING
Sullivan Machinery Co., Chicago, Ill.

ANNUNCIATOR WIRES & CABLES
John A. Roebling's Sons Co., Trenton, New Jersey.

ANNUNCIATOR WIRES & CABLES, INSULATED
American Steel & Wire Co., Chicago, Ill., and New York.

ARMATURE COILS & LEADS
John A. Roebling's Sons Co., Trenton, New Jersey.

AUTOMATIC CAR CAGES
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Roberts & Schaefer Co., Chicago, Ill.

AUTOMATIC CAR DUMPERS
Roberts & Schaefer Co., Chicago, Ill.

AUTOMATIC (Mine Doors, Truck and Electric Switches)
American Mine Door Co., Canton, Ohio.

AUTOMATIC SWITCH THROWERS
American Mine Door Co., Canton, Ohio.

AUTOMOBILE CABLES
John A. Roebling's Sons Co., Trenton, New Jersey.

BALLAST UNLOADER ROPES
John A. Roebling's Sons Co., Trenton, New Jersey.

BARS, STEEL
Carnegie Steel Co., Pittsburgh, Pa.

BATTERIES, DRY (for Bells, Buzzers, Signals, Blasting)
National Carbon Co., Inc., 30 East 42nd St., New York City.

BATTERIES (Storage, Gas Welding, Cutting, Dissolved Acetylene)
Prest-O-Lite Co., 30 East 42d St., New York City.

BELL CORD
John A. Roebling's Sons Co., Trenton, New Jersey.

BELTING (Conveyor, Elevator, Transmission)
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

BELTING, SILENT CHAIN
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

BINS (Coke and Coal)
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

BITS Carbon (Diamonds) for Core Drill
R. S. Patrick, Sellwood Building, Duluth, Minn.

BITS, Diamond Drilling
R. S. Patrick, Sellwood Building, Duluth, Minn.

BIT SHARPENERS
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City.

BLACK DIAMONDS
R. S. Patrick, Sellwood Building, Duluth, Minn.

BLASTING POWDER
Atlas Powder Co., Wilmington, Del.
E. I. Du Pont de Nemours & Co., Inc., Wilmington, Del.
Hercules Powder Co., 934 King St., Wilmington, Del.

BLASTING SUPPLIES
Atlas Powder Co., Wilmington, Del.
E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.
Hercules Powder Co., 934 King St., Wilmington, Del.

BLASTING UNITS (Dry Battery)
National Carbon Co., Inc., 30 East 42nd St., New York City.

BLOWERS, CENTRIFUGAL
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Robinson Ventilating Co., Zelienople, Pa.

BLOWERS (Tubing)
Robinson Ventilating Co., Zelienople, Pa.

BLOWERS (Turbine)
Robinson Ventilating Co., Zelienople, Pa.

BLOWPIPES, Brazing, Carbon Burning, Cutting, Lead Burning, Welding, Welding and Cutting
Oxweld Acetylene Co., 30 E. 42d St., New York City.

BLUE CENTER STEEL WIRE ROPE
John A. Roebling's Sons Co., Trenton, New Jersey.

BOND TERMINALS
Amer. Mine Door Co., Canton, Ohio.

BORTZ
R. S. Patrick, Sellwood Building, Duluth, Minn.

BREAKER MACHINERY
American Rheolaveur Corporation, Wilkes-Barre, Pa.
Vulcan Iron Works, Wilkes-Barre, Pa.

BREAKERS (Construction and Machinery)
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

BREAST MACHINES
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.

BRIQUETTING MACHINERY
Vulcan Iron Works, Wilkes-Barre, Pa.

BRUSHES (Carbon, Graphite and Metal Graphite for Electric Motors, Generators and Converters)
National Carbon Co., Inc., Cleveland, Ohio and San Francisco, Calif.

BUCKETS (Elevator)
Hendrick Mfg. Co., Carbondale, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CABLE GREASE
Keystone Lubricating Co., Philadelphia, Pa.

CABLES
American Steel & Wire Co., Chicago and New York.
A. Leschen & Sons Rope Co., St. Louis, Mo.

CABLES (Connectors and Guides)
American Mine Door Co., Canton, Ohio.
Leschen & Sons Rope Co., A., St. Louis, Mo.

CABLES, INSULATED
John A. Roebling's Sons Co., Trenton, New Jersey.

CABLES, SUSPENSION BRIDGE
John A. Roebling's Sons Co., Trenton, New Jersey.

CABLEWAYS
American Steel & Wire Co., Chicago, Ill., and New York.
S. Flory Mfg. Co., Bangor, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

CAGE DUMPERS, ROTARY
Roberts & Schaefer Co., Chicago, Ill.

CAGE (Safety Appliances)
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

CAGE STOPS & LOCKS
Mining Safety Device Co., Bowerston, Ohio.
Roberts & Schaefer Co., Chicago, Ill.

CAGERS, AUTOMATIC
Mining Safety Device Co., Bowerston, Ohio.

CAGERS, AUTOMATIC & MANUAL
Roberts & Schaefer Co., Chicago, Ill.

CAGES
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Vulcan Iron Works, Wilkes-Barre, Pa.

CAGES (Self-dumping)
Roberts & Schaefer Co., Chicago, Ill.

CALCINERS
Vulcan Iron Works, Wilkes-Barre, Pa.

CALCIUM CARBIDE
Union Carbide Sales Co., 30 East 42nd St., New York City.

CARBON AND BORTZ
R. S. Patrick, Sellwood Building, Duluth, Minn.

CARBON FOR DIAMOND DRILLING
R. S. Patrick, Sellwood Building, Duluth, Minn.

CARBON BURNING APPARATUS
Oxweld Acetylene Co., 30 E. 42d St., New York City.

CARBON ELECTRODES (for Electric Furnaces and Electrolytic Work)
National Carbon Co., Inc., Electrode Sales Division, 30 East 42nd St., New York City.

CARBONS (for Arc Lamps, Blue Printing, Photographic)
National Carbon Co., Inc., Cleveland, Ohio and San Francisco, Calif.

CARBON RODS AND PASTE FOR WELDING
Oxweld Acetylene Co., 30 E. 42d St., New York City.
National Carbon Co., Inc., Cleveland, Ohio and San Francisco, Calif.

CARBON SPECIALTIES (Circuit Breaker Contacts, Packing Rings, Filter Plates, Tubes, etc.)
National Carbon Co., Inc., Cleveland, Ohio and San Francisco, Calif.

CAR DUMPERS, GRAVITY & POWER
Roberts & Schaefer Co., Chicago, Ill.

CAR DUMPERS (Rotary)
Link-Belt Co., 300 W. Pershing Road, Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.

CAR FEEDERS
Roberts & Schaefer Co., Chicago, Ill.

CAR HAULS
Goodman Mfg. Co., Halstead St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.

CAR PULLERS
S. Flory Mfg. Co., Bangor, Pa.

CAR RETARDERS
Roberts & Schaefer Co., Chicago, Ill.

CAR STOPS, AUTOMATIC & MANUAL
Roberts & Schaefer Co., Chicago, Ill.

CAR WIRE & CABLES
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, New Jersey.

CASTINGS
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CASTINGS, GRAY IRON
Link-Belt Co., 300 W. Pershing Road, Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.

CASTINGS, OPEN HEARTH STEEL
Vulcan Iron Works, Wilkes-Barre, Pa.

CHAINS
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, AUTOMOBILE ENGINE
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, COAL CUTTING
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

CHAINS, DRIVE
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, FRONT END
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, OILING
Morse Chain Co., Ithaca, N. Y.

CHAINS, POWER TRANSMISSION
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS Silent (Bushed-Pin Joint)
Link-Belt Co., 300 W. Pershing Road, Chicago, Ill.

CHAINS, SILENT (Rocker-Joint)
Morse Chain Co., Ithaca, N. Y.

CHAINS, SLING
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, SPROCKET WHEEL
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CLAMPS, HOSE
Knox Mfg. Co., Philadelphia, Pa.

CLAMPS (Trolley)
Ohio Brass Co., Mansfield, Ohio.

CLAMPS, WIRE ROPE
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, New Jersey

CLIPS, WIRE ROPE
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, New Jersey

CLUTCHES
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

COAL CLEANING MACHINERY
American Rheolaveur Corporation, Wilkes-Barre, Pa.
Link-Belt Co., 300 W. Pershing Road, Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.

COAL COMPANIES
General Coal Company, Land Title Bldg., Philadelphia, Pa.
Lehigh Coal & Navigation Co., Philadelphia, Pa.
Thorne, Neale & Co., Philadelphia, Pa.

COAL CRUSHERS
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

COAL CRUSHERS & ROLLS
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.

COAL CUTTERS
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.
Howells Mining Drill Co., Plymouth, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

COAL HANDLING MACHINERY
Conveyor Sales Co., Inc., 299 Broadway, New York City.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.

COAL LOADERS
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

COAL MINING MACHINERY
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.
Howells Mining Drill Co., Plymouth, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

COAL MINING PLANTS
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.

COAL SEPARATORS (Pneumatic)
Roberts & Schaefer Co., Chicago, Ill.

COMPRESSORS, AIR
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co., 11 Broadway, New York City.

COMPRESSORS, MINE CAR
Ingersoll-Rand Co., 11 Broadway, New York City.

CONCENTRATORS (Table)
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

CONCRETE REINFORCEMENT
American Steel & Wire Co., Chicago, and New York.

CONDENSERS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co., 11 Broadway, New York City.

CONTROLLERS
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.

CONVERTORS, COPPER
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

CONVEYORS
Conveyor Sales Co., Inc., 299 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.

CONVEYOR BEARINGS
Link-Belt Co., 300 W. Pershing Road, Chicago, Ill.

CONVEYORS, BELT
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CONVEYORS, CHAIN FLIGHT
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CONVEYORS, COAL
Conveyor Sales Co., Inc., 299 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-belt Co., 300 W. Pershing Rd., Chicago, Ill.

CONVEYORS AND ELEVATORS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Conveyor Sales Co., Inc., 299 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-belt Co., 300 W. Pershing Rd., Chicago, Ill.

CONVEYORS, PAN OR APRON
Conveyor Sales Co., Inc., 299 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CONVEYORS, SCREW
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-belt Co., 300 W. Pershing Rd., Chicago, Ill.

COOLERS, Man
Robinson Ventilating Co., Zelienople, Pa.

COOLERS, ROTARY
Vulcan Iron Works, Wilkes-Barre, Pa.

COPPER WIRE & STRAND (Bare)
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, New Jersey

CORE DRILLS, Carbon (Diamonds) for
R. S. Patrick, Sellwood Building, Duluth, Minn.

CORE DRILLING
H. R. Ameling Prospecting Co., Rolla, Mo.
Hoffman Bros., Punxsutawney, Pa.
Mott Core Drilling Co., Huntington, W. Va.

COUPLINGS, FLEXIBLE
Fawcus Machine Co., Pittsburgh, Pa.

COUPLINGS, ROCK DRILL
Knox Mfg. Co., Philadelphia, Pa.

CROSSINGS AND CROSSOVERS
Central Frog & Switch Co., Cincinnati, Ohio.

CROSSOVERS
Sweet's Steel Co., Williamsport, Pa.

CRUSHERS
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

CRUSHERS, COAL
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CRUSHERS, SINGLE & DOUBLE ROLL
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CRUSHING PLANTS, COKE
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershig Rd., Chicago, Ill.

CUP GREASE
Keystone Lubricating Co., Philadelphia, Pa.

CUTTING APPARATUS, Oxy-Acetylene, Oxy-Hydrogen
Oxweld Acetylene Co., 30 E. 42d St., New York City.

DECARBONIZING APPARATUS
Oxweld Acetylene Co., 30 E. 42d St., New York City.

DESIGNERS OF PLANTS
American Rheolaveur Corporation, Wilkes-Barre, Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.

DIAMOND CORE DRILL CONTRACTING
H. R. Ameling Prospecting Co., Rolla, Mo.
Hoffman Bros., Punxsutawney, Pa.
Mott Core Drilling Co., Huntington, W. Va.
Sullivan Machinery Co., Chicago, Ill.

DIAMOND DRILLING CARBON
R. S. Patrick, Sellwood Building, Duluth, Minn.

DIAMONDS, BLACK (See Carbon and Bortz)
R. S. Patrick, Sellwood Building, Duluth, Minn.

DIAMONDS, INDUSTRIAL
R. S. Patrick, Sellwood Building, Duluth, Minn.

DIGGERS & PICKS, Pneumatic
Ingersoll-Rand Co., New York City.

DITCHING MACHINES
Keystone Churn Drill Co., Beaver Falls, Pa.

DOORS, AUTOMATIC MINE
American Mine Door Co., Canton, Ohio.

DOWNIE DEEP WELL PUMPS
Keystone Churn Drill Co., Beaver Falls, Pa.

DRIFTERS, DRILL
Ingersoll-Rand Co., 11 Broadway, New York City.

DRILLING CONTRACTORS
Pennsylvania Drilling Co., Pittsburgh, Pa.

DRILLING, DIAMONDS FOR
R. S. Patrick, Sellwood Building, Duluth, Minn.

DRILLS, AIR AND STEAM
Howells Mining Drill Co., Plymouth, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.

DRILLS (Blast Hole)
Howells Mining Drill Co., Plymouth, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.
Keystone Churn Drill Co., Beaver Falls, Pa.

DRILL BITS, Carbon (Diamonds) for
R. S. Patrick, Sellwood Building, Duluth, Minn.

DRILL, Carbon (Diamonds) for
R. S. Patrick, Sellwood Building, Duluth, Minn.

DRILL COLUMNS & MOUNTINGS
Ingersoll-Rand Co., New York City.

DRILLER'S DIAMONDS
R. S. Patrick, Sellwood Building, Duluth, Minn.

DRILLS, CORE
H. R. Ameling Prospecting Co., Rolla, Mo.
Hoffman Bros., Punxsutawney, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.
Keystone Churn Drill Co., Beaver Falls, Pa.
Mott Core Drilling Co., Huntington, W. Va.

DRILLS, DIAMOND GASOLINE OUTFITS
Mott Core Drilling Co., Huntington, W. Va.

DRILLS, ELECTRIC
General Electric Co., Schenectady, N. Y.
Howells Mining Drill Co., Plymouth, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

DRILLS, HAMMER
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

DRILLS (Hand Operated Coal)
Howells Mining Drill Co., Plymouth, Pa.
Ohio Brass Co., Mansfield, Ohio.

DRILLS, MINERAL PROSPECTING
Keystone Churn Drill Co., Beaver Falls, Pa.
Mott Core Drilling Co., Huntington, W. Va.

DRILLS, PNEUMATIC
Howells Mining Drill Co., Plymouth, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.

DRILLS, PROSPECTING
H. R. Ameling Prospecting Co., Rolla, Mo.
Hoffman Bros., Punxsutawney, Pa.
Howells Mining Drill Co., Plymouth, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.
Keystone Churn Drill Co., Beaver Falls, Pa.
Mott Core Drilling Co., Huntington, W. Va.

DRILLS, ROCK
Diamond Machine Co., Monongahela, Pa.
General Electric Co., Schenectady, N. Y.
Howells Mining Drill Co., Plymouth, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

DRILL STEEL SHARPENERS
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

DRIVES, SILENT CHAIN
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

DRUMS (Hoisting, Haulage)
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

DRYERS, ROTARY
Vulcan Iron Works, Wilkes-Barre, Pa.

DUMP CARS
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

DUMPS, ROTARY
Roberts & Schaefer Co., Chicago, Ill.

DYNAMITE
Atlas Powder Co., Wilmington, Del.
E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.
Hercules Powder Co., 934 King St., Wilmington, Del.

DYNAMOS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Goodman Mfg. Co., Forty-eighth Place and Halsted St., Chicago, Ill.

ELECTRICAL APPARATUS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.

ELECTRICAL CABLES & WIRES
American Steel & Wire Co., Chicago, Ill., and New York.

ELECTRIC DRILLS
Howells Mining Drill Co., Plymmouth, Pa.

ELECTRIC HOISTING MACHINERY
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

ELECTRIC LOCOMOTIVES
General Electric Co., Schenectady, N. Y.
Goodman Mfg. Co., Forty-eighth Place and Halsted St., Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Ohio Brass Co., Mansfield, Ohio.

ELECTRIC LOCOMOTIVE CABLES
John A. Roebling's Sons Co., Trenton, New Jersey.

ELECTRIC MINE SUPPLIES
General Electric Co., Schenectady, N. Y.
Ohio Brass Co., Mansfield, Ohio.

ELECTRIC WIRES AND CABLES
American Steel & Wire Co., Chicago and New York.

ELECTRICAL SUPPLIES
General Electric Co., Schenectady, N. Y.

ELECTRICAL WIRES & CABLES
John A. Roebling's Sons Co., Trenton, New Jersey.

ELECTRODES, WELDING
John A. Roebling's Sons Co., Trenton, New Jersey.

ELEVATORS
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

ELEVATORS, BUCKET
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

ELEVATOR CABLES & ROPES
John A. Roebling's Sons Co., Trenton, New Jersey.

ELEVATOR MACHINERY
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

ENGINES, GAS AND GASOLINE
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co., 11 Broadway, New York City.

ENGINES (Hoisting and Hauling)
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

ENGINES, OIL
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co., 11 Broadway, New York City.

ENGINES, Rope Haulage
S. Flory Mfg. Co., Bangor, Pa.

ENGINES, STEAM
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co., 11 Broadway, New York City.

ENGINES, Winding
S. Flory Mfg. Co., Bangor, Pa.

ENGINEERS
H. R. Ameling Prospecting Co., Rolla, Mo.

EXCAVATORS
Keystone Churn Drill Co., Beaver Falls, Pa.

EXPLOSIVES
Atlas Powder Co., Wilmington, Del.
du Pont Powder Co., The E. I., Wilmington, Del.
Hercules Powder Co., 934 King St., Wilmington, Del.

FAN DRIVES
Fawcus Machine Co., Pittsburgh, Pa.
Link-Belt Co., 300 W. Pershing Road, Chicago, Ill.

FANS, Man Cooling
Robinson Ventilating Co., Zelienople, Pa.

FANS, Turbine
Robinson Ventilating Co., Zelienople, Pa.

FANS, VENTILATING
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Robinson Ventilating Co., Zelienople, Pa.
Vulcan Iron Works, Wilkes-Barre, Pa.

FEEDERS (Crossover, Kickback, Rotary and Dump)
Link-Belt Co., 300 W. Pershing Road, Chicago, Ill.
Mining Safety Device Co., Bowerston, Ohio.
Roberts & Schaefer Co., Chicago, Ill.

FEEDERS (Hand Operated)
Mining Safety Device Co., Bowerston, Ohio.
Roberts & Schaefer Co., Chicago, Ill.

FEEDERS, ORE
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

FEEDERS (Semi-automatic)
Mining Safety Device Co., Bowerston, Ohio.

FENCE POSTS
Sweet's Steel Co., Williamsport, Pa.

FIRE AND WEATHERPROOF WIRE
John A. Roebling's Sons Co., Trenton, New Jersey.

FLASHLIGHTS AND BATTERIES (Mine Safety)
National Carbon Co., Inc., 30 East 42nd St., New York City.

FLOORING, STEEL
Hendrick Mfg. Co., Carbondale, Pa.

FLOTATION MACHINES
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

FLOTATION OILS
Hercules Powder Co., 934 King St., Wilmington, Del.

FLOW METERS
General Electric Co., Schenectady, N. Y.

FLUX, WELDING
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

FORGINGS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

FROGS
Sweet's Steel Co., Williamsport, Pa.

FROGS AND SWITCHES
Amer. Mine Door Co., Canton, Ohio.
Central Frog & Switch Co., Cincinnati, Ohio.
West Virginia Rail Co., Huntington, W. Va.

FURNACES, Oil (for drill steel)
Ingersoll-Rand Co., New York City.

FURNACES, ROASTING
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

GAS (Cutting, Welding)
Prest-O-Lite Co., Inc., 30 E. 42nd St., New York City.

GAS (Nitrogen, Oxygen)
Linde Air Products Co., 30 E. 42nd St., New York City.

GAUGES, WELDING
Oxweld Acetylene Co., 30 E. 42nd St. New York City.

GEARS
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

GEARS, BEVEL
Fawcus Machine Co., Pittsburgh, Pa.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Road, Chicago, Ill.

GEARS, HERRINGBONE
Fawcus Machine Co., Pittsburgh, Pa.
Link-Belt Co., 300 W. Pershing Road, Chicago, Ill.

GEARS, Machine Cut
Link-Belt Co., 300 W. Pershing Road, Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.

GEARS, Moulded Tooth
Link-Belt Co., 300 W. Pershing Road, Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.

GEARS, SILENT CHAIN
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

GEARS, SPUR
Fawcus Machine Co., Pittsburgh, Pa.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Road, Chicago, Ill.

GEARS, WORM
Fawcus Machine Co., Pittsburgh, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

GEARS, WORM WHEELS
Fawcus Machine Co., Pittsburgh, Pa.

GENERATORS AND GENERATING SETS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.

GENERATORS, ACETYLENE
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

GLOVES, ASBESTOS
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

GOGGLES, WELDING
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

GRATING, AREA, SIDEWALK
Hendrick Mfg. Co., Carbondale, Pa.

GREASE
Keystone Lubricating Co., Philadelphia, Pa.

GRINDERS, Portable Pneumatic
Ingersoll-Rand Co., New York City.

GUY ROPES, GALVANIZED
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, New Jersey.

HAMMERS, Calking, Chipping & Riveting
Ingersoll-Rand Co., New York City.

HANGERS (Insulated Trolley)
Ohio Brass Co., Mansfield, Ohio.

HAULAGE ROPE
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, New Jersey.

HEADLIGHTS, ARC AND INCANDESCENT
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Ohio Brass Co., Mansfield, Ohio.

HEATER CORD
John A. Roebling's Sons Co., Trenton, New Jersey.

HERRINGBONE GEAR DRIVES
Fawcus Machine Co., Pittsburgh, Pa.
Link-Belt Co., 300 W. Pershing Road, Chicago, Ill.

HOIST DRIVES
Link-Belt Co., 300 W. Pershing Road, Chicago, Ill.

HOISTING ROPES
American Steel & Wire Co., Chicago, Ill., and New York.
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
A. Leschen & Sons Rope Co., St. Louis, Mo.
John A. Roebling's Sons Co., Trenton, New Jersey.

HOISTS
American Steel & Wire Co., Chicago and New York.
Ingersoll-Rand Co., 11 Broadway, New York City.
Link-Belt Co., 300 W. Pershing Road, Chicago, Ill.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

HOISTS, AIR
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

HOISTS, ELECTRIC
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Diamond Machine Co., Monongahela, Pa.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.

HOISTS, PORTABLE
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

HOISTS, Derrick
S. Flory Mfg. Co., Bangor, Pa.

HOISTS, GASOLINE
S. Flory Mfg. Co., Bangor, Pa.

HOISTS, Room
S. Flory Mfg. Co., Bangor, Pa.

HOISTS, Room and Gathering
S. Flory Mfg. Co., Bangor, Pa.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.

HOISTS, Scraper-Loader
Ingersoll-Rand Co., New York City.

HOISTS, Shaft, Electric
S. Flory Mfg. Co., Bangor, Pa.

HOISTS, Shaft, Steam
S. Flory Mfg. Co., Bangor, Pa.

HOISTS, Shaker Chute
S. Flory Mfg. Co., Bangor, Pa.

HOISTS, Slope, Electric
S. Flory Mfg. Co., Bangor, Pa.

HOISTS, Slope, Steam
S. Flory Mfg. Co., Bangor, Pa.

HOISTS, STEAM
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.
Vulcan Iron Works, Wilkes-Barre, Pa.

HOLDERS-ON RIVETING
Ingersoll-Rand Co., New York City.

HOOKS
John A. Roebling's Sons Co., Trenton, New Jersey.

HOSE, AIR AND STEAM
Ingersoll-Rand Co., 11 Broadway, New York City.

HOSE CLAMPS
Knox Mfg. Co., 811-821 Cherry St., Philadelphia, Pa.

HOSE COUPLINGS
Knox Mfg. Co., 811-821 Cherry St., Philadelphia, Pa.

HOSE CONNECTIONS, SPECIAL
Knox Mfg. Co., 811-821 Cherry St., Philadelphia, Pa.

HOSE MENDERS
Knox Mfg. Co., 811-821 Cherry St., Philadelphia, Pa.

HOSE NIPPLES
Knox Mfg. Co., 811-821 Cherry St., Philadelphia, Pa.

HOSE, WELDING
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

HYDRATORS, LIME
Vulcan Iron Works, Wilkes-Barre, Pa.

INCINERATORS
Vulcan Iron Works, Wilkes-Barre, Pa.

INSULATORS, FEEDER WIRE
Ohio Brass Co., Mansfield, Ohio.

INSULATORS, SECTION
Amer. Mine Door Co., Canton, Ohio.
Ohio Brass Co., Mansfield, Ohio.

INSULATORS (Porcelain)
Ohio Brass Co., Mansfield, Ohio.

INSULATORS (Third Rail)
Ohio Brass Co., Mansfield, Ohio.

INSULATORS (Trolley)
General Electric Co., Schenectady, N. Y.
Ohio Brass Co., Mansfield, Ohio.

INSULATED WIRE AND CABLE
American Steel & Wire Co., Chicago, Ill.
Roebling Sons, John A., Trenton, N. J.

KEYSTONE DRILLS
Keystone Churn Drill Co., Beaver Falls, Pa.

KEYSTONE EXCAVATORS
Keystone Churn Drill Co., Beaver Falls, Pa.

KILNS (Rotary)
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Vulcan Iron Works, Wilkes-Barre, Pa.

KILNS, VERTICAL
Vulcan Iron Works, Wilkes-Barre, Pa.

LAMP CORD
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, New Jersey.

LAMPS, ARC AND INCANDESCENT
General Electric Co., Schenectady, N. Y.

LEAD BURNING APPARATUS, Oxy-Acetylene, Oxy-City Gas
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

LIGHT STEEL ANGLES
Sweet's Steel Co., Williamsport, Pa.
Carnegie Steel Co., Pittsburgh, Pa.

LIGHT STEEL RAILS
Carnegie Steel Co., Pittsburgh, Pa.

LIGHT STEEL RAILS (A. S. C. E. Sections)
Sweet's Steel Co., Williamsport, Pa.

LOADERS (Mine Car)
The Colodor Co., Columbus, Ohio.
Conveyor Sales Co., Inc., 299 Broadway, New York City.
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

LOADERS, PORTABLE
Conveyor Sales Co., Inc., 299 Broadway, New York City.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

LOADING BOOMS
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.

LOADING MACHINES
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Conveyor Sales Co., Inc., 299 Broadway, New York City.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

LOCOMOTIVES, ELECTRIC
General Electric Co., Schenectady, N. Y.
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

LOCOMOTIVES, GASOLINE
Vulcan Iron Works, Wilkes-Barre, Pa.

LOCOMOTIVES, RACK RAIL
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.

LOCOMOTIVES, STEAM
Vulcan Iron Works, Wilkes-Barre, Pa.

LOCOMOTIVES, STORAGE BATTERY
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

LOCOMOTIVE SWITCHING & WRECKING ROPES

LOCOMOTIVES (Third Rail)
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
John A. Roebling's Sons Co., Trenton, New Jersey.

LOCOMOTIVES, TROLLEY
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.

LONGWALL MACHINES
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.

LUBRICANTS
Keystone Lubricating Co., Philadelphia, Pa.

LUBRICATORS
Keystone Lubricating Co., Philadelphia, Pa.

MACHINERY, TRANSMISSION (Power)
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

MANIFOLDS, OXYGEN
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

MAST ARM ROPE, Galvanized
John A. Roebling's Sons Co., Trenton, New Jersey

MENDERS, HOSE
Knox Mfg. Co., Philadelphia, Pa.

MILLS, ROD & BALL
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

MILLS, STAMP
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

MINE CAR LUBRICATING
Keystone Lubricating Co., Philadelphia, Pa.

MINE-CARS
Enterprise Wheel & Car Corporation, Huntington, W. Va.

MINE DOORS, AUTOMATIC
American Mine Door Co., Canton, Ohio.

MINE LOCOMOTIVE CABLE
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, New Jersey

MINE SIGNALS
American Mine Door Co., Canton, Ohio.

MINING & METALLURGICAL MACHINERY
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

MINING EQUIPMENT
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Howells Mining Drill Co., Plymouth, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

MINING MACHINE CABLE
John A. Roebling's Sons Co., Trenton, New Jersey.

MINING MACHINES
Goodman Mfg. Co., Forty-eighth Place and Halsted St., Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

MINING MACHINES (Electric)
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.
Howells Mining Drill Co., Plymouth, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

MINING MACHINES (Government Approved)
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.

MINING MACHINERY
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Howells Mining Drill Co., Plymouth, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

MINING SPECIALTIES
Knox Mfg. Co., 811-821 Cherry St., Philadelphia, Pa.

MOTORS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.

MOUNTED BOTTOM CUTTERS
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.

MOVING PICTURE CORD
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, New Jersey.

NIPPLES, HOSE
Knox Mfg. Co., Philadelphia, Pa.

NITROGEN GAS
Linde Air Products, 30 East 42nd St., New York City.

NOZZLES, MALLEABLE IRON
Knox Mfg. Co., Philadelphia, Pa.

OILERS, ROCK DRILL
Knox Mfg. Co., 811-821 Cherry St., Philadelphia, Pa.

OIL RIGS, PORTABLE
Keystone Churn Drill Co., Beaver Falls, Pa.

ORE, BUYERS AND SELLERS OF
Irvington Smelting & Refining Works, Irvington, N. J.
Phelps-Dodge Corporation, New York City.

ORE, CARNOTITE & VANADIUM
O. Barlow Willmarth, Georgetown, Colo.

OVERCUTTING MACH'S.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.

OXYGEN GAS
Linde Air Products, 30 East 42nd St., New York City.

OXY-ACETYLENE APPARATUS and SUPPLIES
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

PATENT ATTORNEY
John Boyle, Jr., Ouray Bldg., Washington, D. C.

PAVING BREAKERS
Ingersoll-Rand Co., New York City.

PERFORATED METAL
Hendrick Mfg. Co., Carbondale, Pa.

PERMISSIBLES, Explosives
Atlas Powder Co., Wilmington, Del.
du Pont Powder Co., The E. I., Wilmington, Del.
Hercules Powder Co., Wilmington, Del.

PICKING TABLES
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.

PIPE (Wood)
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

PNEUMATIC HOSE COUPLINGS
Knox Mfg. Co., 811-821 Cherry St., Philadelphia, Pa.

PNEUMATIC TOOL
Ingersoll-Rand Co., 11 Broadway, New York City.

POWDER, BLASTING
Atlas Powder Co., Wilmington, Del.
E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.
Hercules Powder Co., 934 King St., Wilmington, Del.

POWER CABLES
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, New Jersey.

POWER SHOVELS
Keystone Churn Drill Co., Beaver Falls, Pa.

POWER TRANSMISSION MACHINERY
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

PREHEATING APPARATUS
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

PRESERVATIVE EQUIPMENT
American Lumber & Treating Corpn., 1138 Lake Shore Drive, Chicago, Ill.
United Wood Treating Corpn., 1138 Lake Shore Drive, Chicago, Ill.

PRESERVATIVES, WOOD
American Lumber & Treating Corpn., 1138 Lake Shore Drive, Chicago, Ill.
United Wood Treating Corpn., 1138 Lake Shore Drive, Chicago, Ill.

PROSPECTIVE DRILLS
H. R. Ameling Prespecting Co., Rolla, Mo.
Hoffman Bros., Punxsutawney, Pa.
Howells Mining Drill Co., Plymouth, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.
Mott Core Drilling Co., Huntington, W. Va.

PULLEYS
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

PULVERIZERS, COAL AND COKE
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

PUMPS, Acid Resisting
Ingersoll-Rand Co., New York City.

PUMPS, AIR LIFT
Ingersoll-Rand Co., 11 Broadway, New York City.

PUMPS, Boiler Feed
Ingersoll-Rand Co., New York City.

PUMPS, CENTRIFUGAL
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works), 11 Broadway, New York City.
Keystone Churn Drill Co., Beaver Falls, Pa.

PUMPS, DEEP WELL
Ingersoll-Rand Co., 11 Broadway, New York City.
Keystone Churn Drill Co., Beaver Falls, Pa.

PUMPS (Electric)
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works), 11 Broadway, New York City.

PUMPS, Fire
Ingersoll-Rand Co., New York City.

PUMPS (Gathering or Dip)
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

PUMPS, Inclined Shaft
Ingersoll-Rand Co., New York City.

PUMPS. MINE
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works), 11 Broadway, New York City.

PUMPS, Sinking
Ingersoll-Rand Co., New York City.

PUMPS, PNEUMATIC AIR LIFT
Ingersoll-Rand Co., 11 Broadway, New York City.

PUMPS, POWER
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works), 11 Broadway, New York City.

PUMPS, SAND
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works), 11 Broadway, New York City.

PUMPS, STEAM
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works), 11 Broadway, New York City.

PUMPS, VACUUM
Ingersoll-Rand Co., 11 Broadway, New York City.

PUNCHES, Drill Steel
Ingersoll-Rand Co., New York City.

QUARRYING MACHINERY
Ingersoll-Rand Co., 11 Broadway, New York City.

QUARRYING SPECIALTIES
Knox Mfg. Co., 811-821 Cherry St., Philadelphia, Pa.

RADIO ACTIVE ORE
O. Barlow Willmarth, Georgetown, Colo.

RADIUM ORE
O. Barlow Willmarth, Georgetown, Colo.

RAIL BONDS
American Steel & Wire Co., Chicago and New York.
Ohio Brass Co., Mansfield, Ohio.

RAILWAY SUPPLIES
Ohio Brass Co., Mansfield, Ohio.

RAMMERS, Pneumatic
Ingersoll-Rand Co., New York City.

RECEIVERS, Air
Ingersoll-Rand Co., New York City.

REGULATORS, Welding, Compressed Gas
Oxweld Acetelyne Co., 30 E. 42nd St., New York City.

REHEATERS, Air
Ingersoll-Rand Co., New York City.

REINFORCING BARS
Sweet's Steel Co., Williamsport, Pa.
West Virginia Rail Co., Huntington, W. Va.

RIVER CROSSING SUSPENSION WIRE, Galvanized
John A. Roebling's Sons Co., Trenton, New Jersey.

RETARDERS
Mining Safety Device Co., Bowerston, Ohio.

ROCK-DISPOSAL EQUIPMENT
Link-Belt Co., 300 W. Pershing Road, Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.

ROCK DRILL COUPLINGS
Knox Mfg. Co., 811-821 Cherry St., Philadelphia, Pa.

ROCK DRILL OILERS
Knox Mfg. Co., 811-821 Cherry St., Philadelphia, Pa.

ROCK DRILLS
Diamond Machine Co., Monongahela, Pa.
Howells Mining Drill Co., Plymouth, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.

ROCK DRILL THROTTLES
Knox Mfg. Co., 811-821 Cherry St., Philadelphia, Pa.

ROCK DUSTING MACHINES
Diamond Machine Co., Monongahela, Pa.

RODS, WELDING
Oxweld Acetelyne Co., 30 E. 42nd St., New York City.

ROLLER BEARINGS
Enterprise Wheel & Car Corporation, Huntington, W. Va.

ROLLS (Crushing)
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

ROPE
American Steel & Wire Co., Chicago and New York.
Leschen & Sons Rope Co., A., St. Louis, Mo.

ROPE GREASE
Keystone Lubricating Co., Philadelphia, Pa.

ROPE, TRANSMISSION
American Steel & Wire Co., Chicago and New York.
Roebling Sons, John A., Trenton, N. J.

ROPE, WIRE
American Steel & Wire Co., Chicago and New York.
Leschen & Sons Rope Co., A., St. Louis, Mo.
Roebling Sons, John A., Trenton, N. J.

ROTARY DUMPS
Link-Belt Co., 300 W. Pershing Road, Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.

ROTARY ROASTERS
Vulcan Iron Works, Wilkes-Barre, Pa.

RUNNING ROPE, Galvanized
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, New Jersey.

SAFETY APPLIANCES, MINE
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

SAND DRYERS
Roberts & Schaefer Co., Chicago, Ill.

SASH CORD
John A. Roebling's Sons Co., Trenton, New Jersey.

SCRAPER LOADERS
Goodman Mfg. Co., Halsted St., and 48th Place, Chicago, Ill.

SCREENS, HORIZONTAL
Link-Belt Co., 300 W. Pershing Road, Chicago, Ill.
Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.

SCREENS, PERFORATED METAL
Hendrick Mfg. Co., Carbondale, Pa.
Link-Belt Co., 300 W. Pershing Road, Chicago, Ill.

SCREENS, REVOLVING
Hendrick Mfg. Co., Carbondale, Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

SCREENS, SHAKER
Hendrick Mfg. Co., Carbondale, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.

SCREENS AND PERFORATED SHEETING
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Hendrick Mfg. Co., Carbondale, Pa.

SCREENS & WASHERIES
American Rheolaveur Corporation, Wilkes-Barre, Pa.

SEIZING STRAND, GALVANIZED
John A. Roebling's Sons Co., Trenton, New Jersey.

SHARPENERS, DRILL
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

SHEAVES
John A. Roebling's Sons Co., Trenton, New Jersey.

SHEAVE WHEELS
Vulcan Iron Works, Wilkes-Barre, Pa.

SHORT WALL ANCHORS
Amer. Mine Door Co., Canton, Ohio.

SHORTWALL MACHINES
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.

SHOVEL — ELECTRO-HYDRAULIC
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.

SIGNAL WIRES & CABLES
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, New Jersey.

SIGNS (Mine)
Stonehouse Signs, Inc., 842 Larimer St., Denver, Colo.

SINKERS, ROCK DRILL
Ingersoll-Rand Co., 11 Broadway, New York City.

SKIPS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Hendrick Mfg. Co., Carbondale, Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.

SKIP LOADING EQUIPMENT
Link-Belt Co., 300 W. Pershing Road, Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.

SLABBING MACHINES
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.

SMELTERS
Irvington Smelting & Refining Works, Irvington, N. J.

SOCKETS, Open and Closed
John A. Roebling's Sons Co., Trenton, New Jersey.

SPECIAL MACHINERY
Fawcus Machine Co., Pittsburgh, Pa.
Vulcan Iron Works, Wilkes-Barre, Pa.

SPEED REDUCERS, DOUBLE
Fawcus Machine Co., Pittsburgh, Pa.
Link-Belt Co., 300 W. Pershing Road, Chicago, Ill.

SPEED REDUCERS, SINGLE
Fawcus Machine Co., Pittsburgh, Pa.
Link-Belt Co., 300 W. Pershing Road, Chicago, Ill.

SPIKES
Sweet's Steel Co., Williamsport, Pa.

SPLICE BARS (Plain and Angle)
Carnegie Steel Co., Pittsburgh, Pa.
Sweet's Steel Co., Williamsport, Pa.

SPLICE, CABLE
American Mine Door Co., Canton Ohio.
Ohio Brass Co., Mansfield, Ohio.

SPLICE, INSULATOR
American Mine Door Co., Canton, Ohio.

SPLICE, TROLLEY WIRE
General Electric Co., Schenectady, N. Y.
Ohio Brass Co., Mansfield, Ohio.

SPLICERS, TROLLEY
Amer. Mine Door Co., Canton, Ohio.

SPROCKETS, COMPENSATING
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

SPROCKETS, SILENT CHAIN
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

SPROCKETS, SPRING
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

SPUR GEAR DRIVES
Fawcus Machine Co., Pittsburgh, Pa.
Link-Belt Co., 300 W. Pershing Road, Chicago, Ill.

STACKS, SMOKE
Hendrick Mfg. Co., Carbondale, Pa.

STARTER CABLES
John A. Roebling's Sons Co., Trenton, New Jersey.

STEAM HOSE COUPLINGS
Knox Mfg. Co., 811-821 Cherry St., Philadelphia, Pa.

STEEL CROSS TIES
Carnegie Steel Co., Pittsburgh, Pa.
Sweet's Steel Co., Williamsport, Pa.

STEEL, HOLLOW & SOLID DRILL
Ingersoll-Rand Co., 11 Broadway, New York City.

STEEL PLATE CONSTRUCTION
Hendrick Mfg. Co., Carbondale, Pa.

STEEL, REINFORCING
American Mine Door Co., Canton, Ohio.

STEEL, SHAPES, PLATES, BARS, ETC.
Carnegie Steel Co., Pittsburgh, Pa.

STEEL TIES AND REINFORCEMENTS
Carnegie Steel Co., Pittsburgh, Pa.
West Virginia Rail Co Huntington, W. Va.

STEPS, SAFETY
Hendrick Mfg. Co., Carbondale, Pa.

STOPERS, ROCK DRILL
Ingersoll-Rand Co., 11 Broadway, New York City.

STORAGE BATTERY LOCOMOTIVES
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Vulcan Iron Works, Wilkes-Barre, Pa.

STRAND
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, New Jersey.

SUCTION HOSE COUPLINGS
Knox Mfg. Co., 811-821 Cherry St., Philadelphia, Pa.

SURVEYOR'S SPADS
Howells Mining Drill Co., Plymouth, Pa.

SWITCHBOARD WIRE AND CABLES
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, New Jersey.

SWITCHBOARDS, POWER
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

SWITCHES
Sweet's Steel Co., Williamsport, Pa.

SWITCHES (Disconnecting and Electric)
General Electric Co., Schenectady, N. Y.

SWITCHES AND FROGS, TROLLEY
American Mine Door Co., Canton, Ohio.
Central Frog & Switch Co., Cincinnati, Ohio.
Ohio Brass Co., Mansfield, Ohio.

TACKLE BLOCKS
John A. Roebling's Sons Co., Trenton, New Jersey.

TELEGRAPH AND TELEPHONE WIRES AND CABLES
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, New Jersey.

TELEPHONE CORDS
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, New Jersey.

THIMBLES
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, New Jersey.

THROTTLES, Rock Drill
Knox Mfg. Co., 811-821 Cherry St., Philadelphia, Pa.

TIES (Steel, Mine)
Carnegie Steel Co., Pittsburgh, Pa.
Central Frog & Switch Co., Cincinnati, Ohio.

TILLER ROPE
John A. Roebling's Sons Co., Trenton, New Jersey.

TIMBER PRESERVING EQUIPMENT
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

TIMBERS, STEEL MINE
Carnegie Steel Co., Pittsburgh, Pa.

TIPPLES
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.

TIPPLE EQUIPMENT
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.

TIRE WIRES
John A. Roebling's Sons Co., Trenton, New Jersey.

TOOLS, Blacksmiths (for drill steel)
Ingersoll-Rand Co., New York City.

TOOLS & SUPPLIES
Keystone Churn Drill Co., Beaver Falls, Pa.

TORCHES, Brazing, Carbon Burning, Cutting, Lead Burning, Welding, Welding and Cutting
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

TRACK BOLTS
Sweet's Steel Co., Williamsport, Pa.

TRACK EQUIPMENT
Carnegie Steel Co., Pittsburgh, Pa.
Sweet's Steel Co., Williamsport, Pa.

TRACK LAYOUTS (Industrial)
Sweet's Steel Co., Williamsport, Pa.

TRACKS, PORTABLE, RAIL, Etc.
Carnegie Steel Co., Pittsburgh, Pa.
Central Frog & Switch Co., Cincinnati, Ohio.
West Virginia Rail Co., Huntington, W. Va.

TRACK (Portable)
Carnegie Steel Co., Pittsburgh, Pa.
Sweet's Steel Co., Williamsport, Pa.

TRACK (Portable, Assembled and Unassembled, Riveted or Bolted)
Carnegie Steel Co., Pittsburgh, Pa.
Central Frog & Switch Co., Cincinnati, Ohio.
West Virginia Rail Co., Huntington, W. Va.

TRACK SUPPLIES
Carnegie Steel Co., Pittsburgh, Pa.
Central Frog & Switch Co., Cincinnati, Ohio.
West Virginia Rail Co., Huntington, W. Va.

TRAMWAYS, AERIAL
American Steel & Wire Co., Chicago, Ill.
Leschen & Sons Rope Co., A., St. Louis, Mo.

TRANSFORMERS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

TRANSMISSION, SILENT CHAIN
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

TREADS, SAFETY STAIR
Hendrick Mfg. Co., Carbondale, Pa.

TROLLEY FROGS
Ohio Brass Co., Mansfield, Ohio.

TROLLEY (Hangers and Clamps)
General Electric Co., Schenectady, N. Y.
Ohio Brass Co., Mansfield, Ohio.

TROLLEY MATERIAL, OVERHEAD
Ohio Brass Co., Mansfield, Ohio.

TROLLEY WHEELS AND HARPS
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.
Ohio Brass Co., Mansfield, Ohio.

TROLLEY WIRE
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, New Jersey.

TRUCKS, WELDER'S
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

TURBINE BLOWERS
Robinson Ventilating Co., Zelienople, Pa.

TURBINES, HYDRAULIC
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

TURBINES, STEAM
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

TURNBUCKLES
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, New Jersey.

TURNOUTS
Sweet's Steel Co., Williamsport, Pa.

VALVES
Ohio Brass Co., Mansfield, Ohio.

VALVES, Back Pressure, Pressure Reducing
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

VALVES, Plug
Knox Mfg. Co., 811-821 Cherry St., Philadelphia, Pa.

VALVES, Quarter Turn
Knox Mfg. Co., 811-821 Cherry St., Philadelphia, Pa.

VALVES, Quick Opening
Knox Mfg. Co., 811-821 Cherry St., Philadelphia, Pa.

VALVES, ROCK DRILL OILER
Knox Mfg. Co., Philadelphia, Pa.

VALVES, ROCK DRILL THROTTLE
Knox Mfg. Co., Philadelphia, Pa.

VALVES, Steam Throttle
Knox Mfg. Co., 811-821 Cherry St., Philadelphia, Pa.

VENTILATING EQUIPMENT
Robinson Ventilating Co., Zelienople, Pa.

VISES, Riggers
John A. Roebling's Sons Co., Trenton, New Jersey.

WAGON LOADERS
Conveyor Sales Co., Inc., 299 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

WASHERIES
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.

WEIGH BASKETS
Roberts & Schaefer Co., Chicago, Ill.

WELDING CARBONS (for Electric Arc and Gas Welding Operations)
National Carbon Co., Inc., Cleveland, Ohio and San Francisco, Calif.

WELDING and CUTTING APPARATUS, Etc. (Oxy-Acetylene)
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

WELDING APPARATUS, ELECTRIC ARC
Ohio Brass Co., Mansfield, Ohio.

WELDING GAS
Prest-O-Lite Co., Inc., 30 E. 42nd St., New York City.

WELDING SUPPLIES
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

WELDING WIRE, Electric
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, New Jersey.

WELDING WIRE, Gas
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, New Jersey.

WELL DRILLING MACHINERY
Keystone Churn Drill Co., Beaver Falls, Pa.

WELL DRILLING MACHINERY
Mott Core Drilling Co., Huntington, W. Va.

WELL DRILLS, for Water, Well and Gas
Keystone Churn Drill Co., Beaver Falls, Pa.

WHEELS, STEEL, MINE CAR AND LOCOMOTIVES
Carnegie Steel Co., Pittsburgh, Pa.

WIRE AND CABLE
American Steel & Wire Co., Chicago and New York.
Roebling Sons, The John A., Trenton, N. J.

WIRE ROPE
American Steel & Wire Co., Chicago, Ill.
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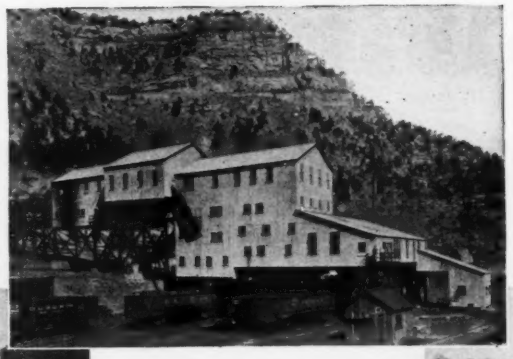

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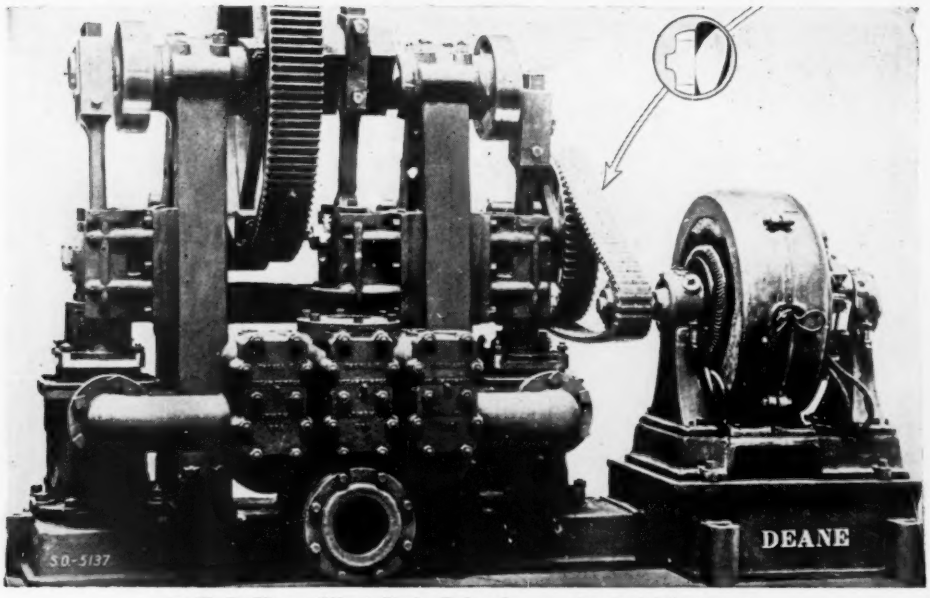

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